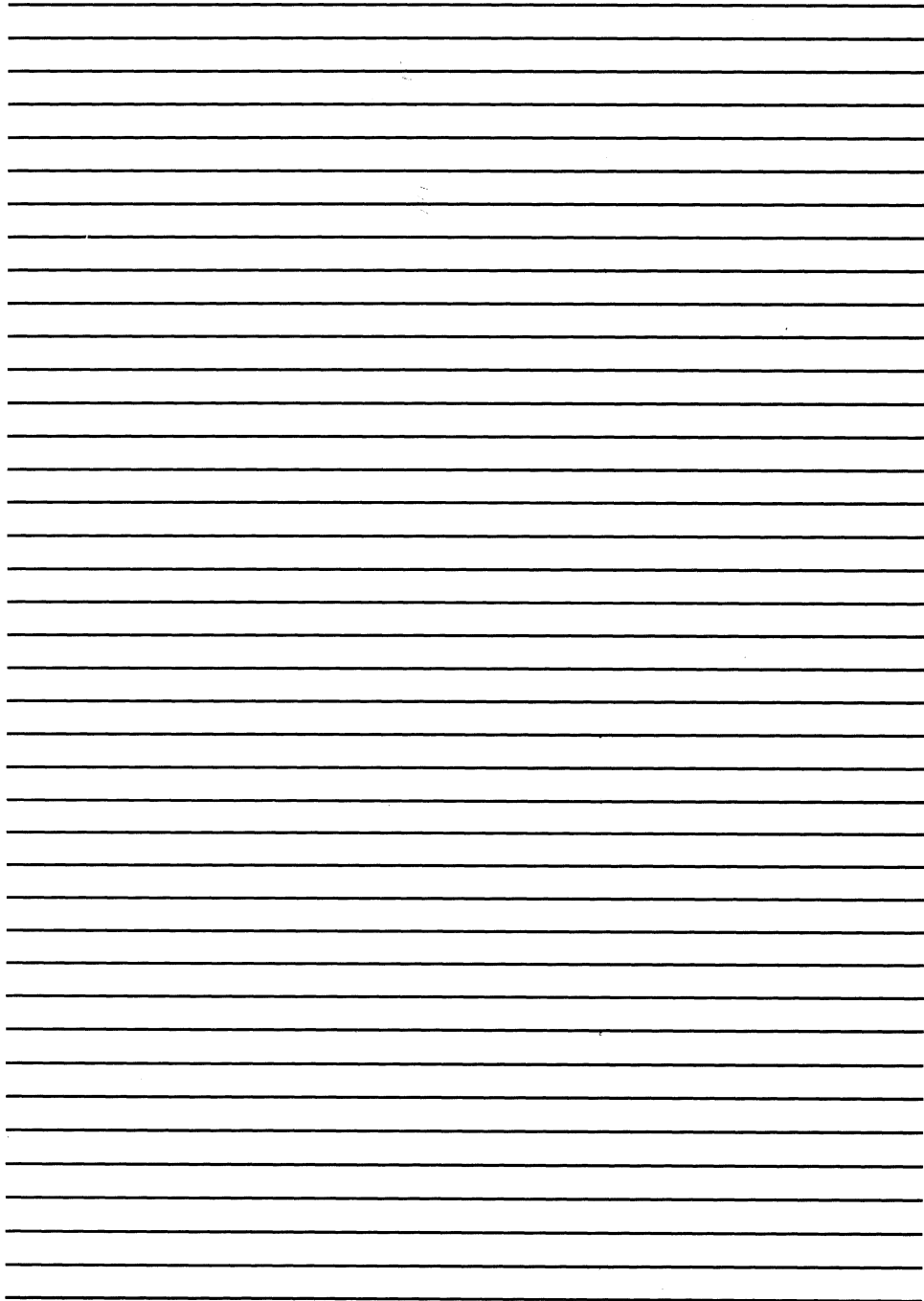


LOTUS

*Controllers
Manual*





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LOTUS
710/720/730
CONTROLLERS
MANUAL

Revision 01

NOTICE

Every attempt has been made to make this manual complete, accurate and up-to-date. However, all information herein is subject to change due to updates. All inquiries concerning this manual should be directed to POINT 4 Data Corporation.

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PREFACE

This manual describes the LOTUS 710 Disk Controller, LOTUS 720 Streaming Tape Controller, and LOTUS 730 Multifunction Controller.

The introduction includes a general description, features, specifications and a description of the LOTUS controller architecture.

Section 2 describes installation and testing of the LOTUS controllers.

Section 3 includes information on disk and tape controller operation, disk formatting, and programming data transfers. Section 3 concludes with programming flowcharts.

Section 4 describes the instruction sets for the LOTUS controllers.

Related Documentation

Related documentation includes:

<u>Title</u>	<u>Pub. Number</u>
MARK 5/9 Computer Reference Manual	HM-085-0032
IRIS R8 Installation and Configuration Manual	SM-030-0009
IRIS R8 Operations Manual	SM-030-0010
IRIS R8 Peripherals Handbook	SM-030-0015



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Section 1

INTRODUCTION

1.1 GENERAL DESCRIPTION

The following paragraphs briefly describe the three LOTUS controllers.

1.1.1 LOTUS 710 DISK CONTROLLER

POINT 4 Data Corporation's LOTUS 710 Disk Controller interfaces a POINT 4 Computer and one to four storage module disk drives. The LOTUS 710 Disk Controller is compatible with Nova* and Nova-type minicomputers. Handshaking and timing signals conform to storage module drive (SMD) interface specifications. Figure 1-1 is a photograph of the LOTUS 710 Disk Controller.

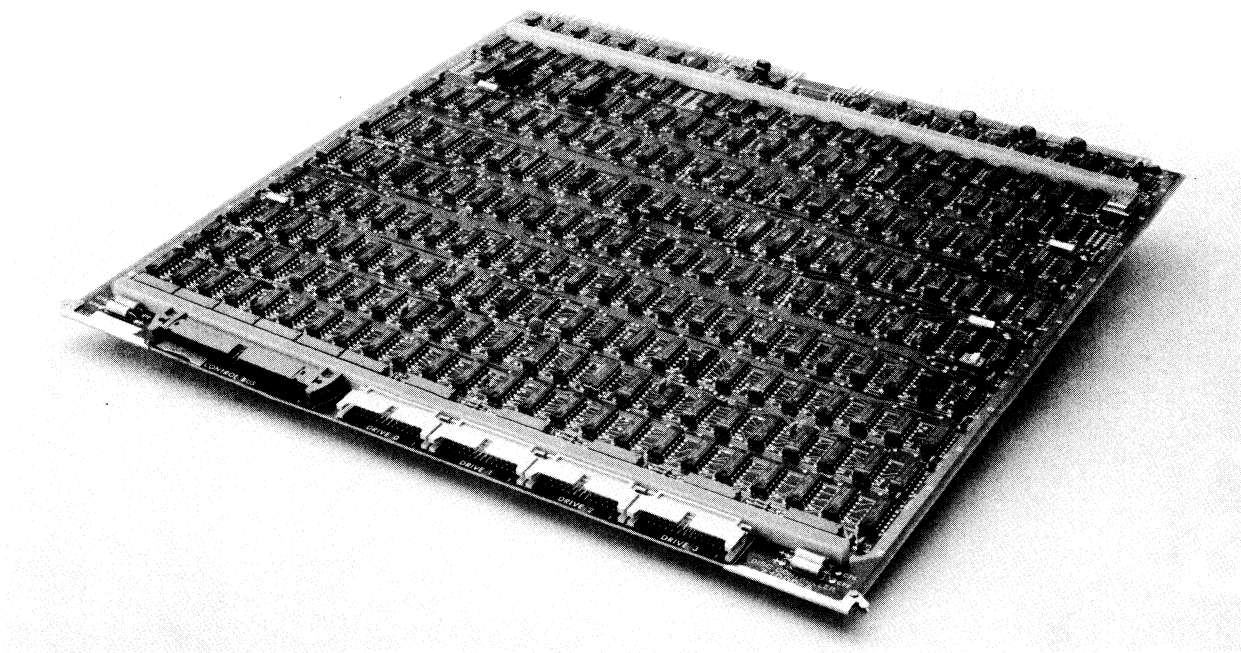


Figure 1-1. LOTUS 710 Disk Controller

*Nova is a trademark of Data General Corporation.

1.1.2 LOTUS 720 STREAMING TAPE CONTROLLER

The LOTUS 720 Streaming Tape Controller interfaces a POINT 4 Computer and one to four streaming tape drives. The LOTUS 720 is compatible with Nova and Nova-type minicomputers. Handshaking and timing signals conform to QIC-02 interface specifications. The LOTUS 720 supports QIC-11 and QIC-24 tape formats. Figure 1-2 is a photograph of the LOTUS 720.

NOTE

QIC-02 is a tape drive-controller interface specification. QIC-11 and QIC-24 are tape format specifications.

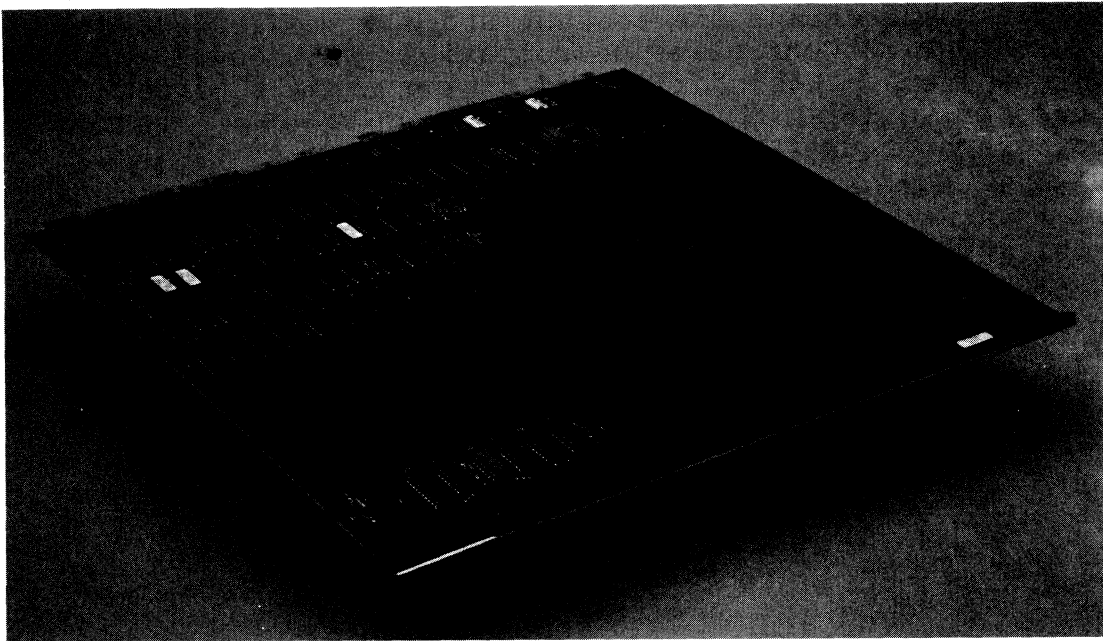


Figure 1-2. LOTUS 720 Streaming Tape Controller

1.1.3 LOTUS 730 MULTIFUNCTION CONTROLLER

The LOTUS 730 Multifunction Controller combines the features of the LOTUS 710 Disk Controller and LOTUS 720 Streaming Tape Controller on one board. Unless otherwise noted, information for the LOTUS 710 and LOTUS 720 applies to the LOTUS 730. Figure 1-3 is a photograph of the LOTUS 730.

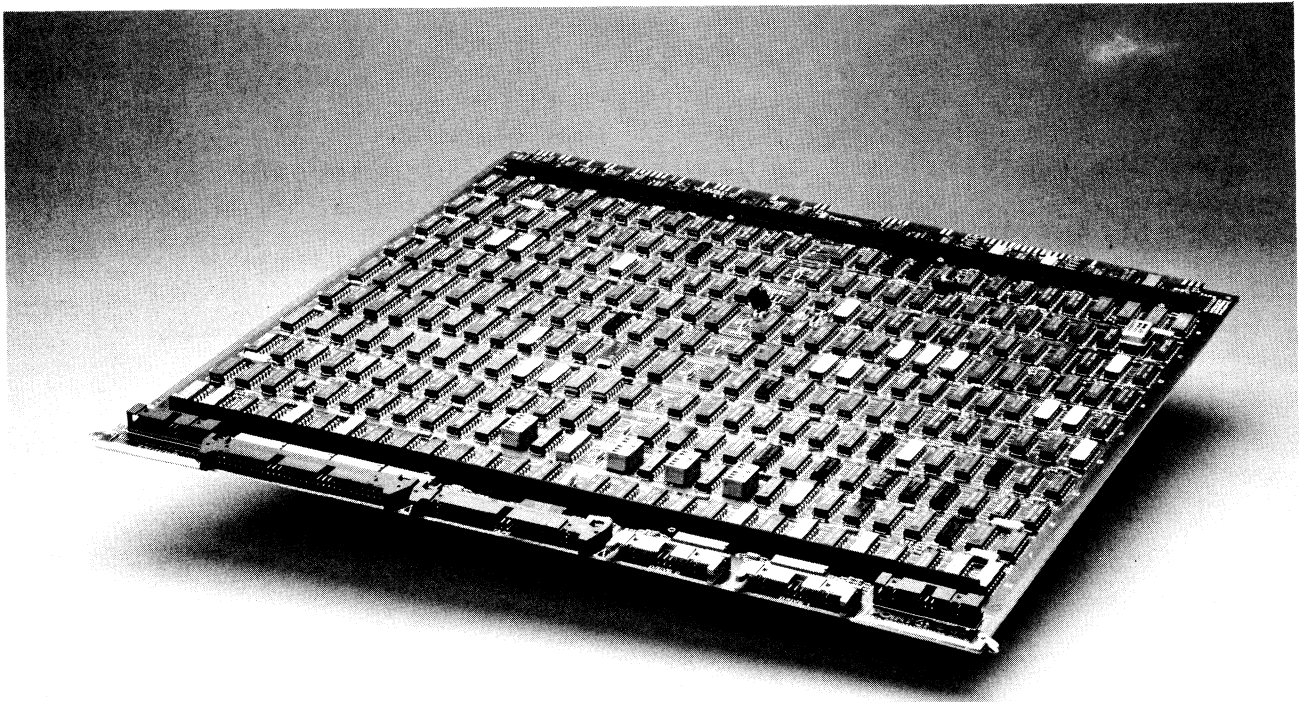


Figure 1-3. LOTUS 730 Multifunction Controller

1.2 FEATURES

Many features make the LOTUS controllers a valuable addition to a POINT 4 computer system. Compatibility, reliability, flexibility and advanced design of the LOTUS 710 Disk Controller and LOTUS 730 Multifunction Controller are apparent in the following features:

- POINT 4 computer I/O bus-compatible
- Nova I/O bus-compatible
- IRIS operating system-compatible
- Interface capability of four storage module-type drives in any combination
- Switch selection for convenient and flexible drive combinations (LOTUS 730 Multifunction Controller only)
- Data transfer rate of 1.209 megabytes per second
- Whole track transfer in a single operation
- Format routine included in controller logic
- Overlapped seek
- 32-bit ECC error detection and provision for software correction of an 11-bit error in any sector
- Bad and alternate sectoring flags
- Disk utility and diagnostic programs

The LOTUS 720 Streaming Tape Controller and LOTUS 730 Multifunction Controller share the following features:

- POINT 4 computer I/O bus-compatible
- Nova I/O bus-compatible
- IRIS operating system-compatible
- QIC-02 interface standard
- Tape block size and disk sector size match
- Convenient disk backup
- Bootstrap PROM
- Support of QIC-11 (20MB) and QIC-24 (45MB) tape formats

1.3 LOTUS CONTROLLER SPECIFICATIONS

Tables 1-1 through 1-6 present the LOTUS controller specifications.

TABLE 1-1. LOTUS-COMPUTER INTERFACE

Item	Parameter
I/O bus	POINT 4 and Nova-type computer I/O bus-compatible
Backplane wiring	None required*
I/O bus loading	Single 7400-type input load; 710: Single 75453-type output driver 720 and 730: Single 75451-type output driver
Device code	Programmable
Priority mask bit	710 and 730: 7 710 only: 8 (Select by jumper) 720 and 730: 12
DMA transfer rate	1.209 megabytes/second (1.65 microsecond/DMA cycle)**
Data channel latency	27 microseconds (disk controllers only)
*Modification of the backplane wiring is necessary in a non-POINT 4 chassis, i.e., jumper pins A94 and A96 (DCHPIN- and INTPIN-).	
**Reference appropriate SMD specification	

TABLE 1-2. DISK DRIVE INTERFACE

Item	Parameter
Disk drives supported	All SMD interface standard-compatible disk drives
Drives per controller	4 maximum
Drive type and size	Any mixture
Cables	A cable - Control bus* B cable - Drive cable*
Number of surfaces per drive	710: 32 maximum** 730: 64 maximum**
Number of tracks per surface	710: 1024 maximum** 730: 2048 maximum**
Number of sectors per track	32 maximum**
Data transfer rate	9.67 MHz maximum***
Access time	1/2 revolution average; 1 revolution maximum**
Sector size: Header Data	6 bytes + 2 bytes of CRC 512 bytes + 4 bytes of ECC
Number of consecutive sectors transferable in one operation	32 maximum
Bad sector flag	1st bit of header
Alternate sector flag	2nd bit of header
Alternate sector location	Any; specified in header
<p>*SMD specification allows use of index and sector signals on either cable. POINT 4 equipment only uses A cable index and sector signals. Index and sector signals on the B cable are not used by POINT 4 equipment.</p>	
<p>**Function of disk drive</p>	
<p>***Reference appropriate SMD specification</p>	

TABLE 1-2. DISK DRIVE INTERFACE (Cont)

Item	Parameter
Program load	From lowest numbered ready drive
FIFO buffer size	18 words
Overlap seek execution	Yes
Alternate sectoring	Yes
ECC error detection	Yes
ECC error correction	Provision for software correction

TABLE 1-3. TAPE DRIVE INTERFACE

Item	Parameter
Tape drives supported	All QIC-02 interface standard-compatible tape drives
Transfer rate	90 kilobytes/second
Block size	512 bytes

TABLE 1-4. PHYSICAL SPECIFICATIONS

Item	Parameter
Dimensions	Single board; 15"x15"
Cabling to disk drives	A cable: 30-pair control bus; daisy-chained; terminated at last drive B cable: 26-wire flat cable; radial; one per drive
Cabling to tape drives	Single cable: 50-wire; daisy-chained; terminated at last drive
Cable connectors	Located at front of controller board

TABLE 1-5. POWER REQUIREMENTS (MAXIMUM)

Item	Parameter
710	+5V $\pm 5\%$, 3.8A -5V $\pm 5\%$, 0.8A
720	+5V $\pm 5\%$, 0.8A
730	+5V $\pm 5\%$, 5.5A -5V $\pm 5\%$, 0.8A

TABLE 1-6. OPERATING ENVIRONMENT

Item	Parameter
Operating temperature	0° to 50°C (32° to 122°F)
Relative humidity	0 to 90% noncondensing

1.4 LOTUS CONTROLLER ARCHITECTURE

LOTUS controller architecture is described in the following paragraphs.

1.4.1 LOTUS 710 DISK CONTROLLER ARCHITECTURE

The LOTUS 710 Disk Controller serves as an interface between the processor and up to four disk drives. Figure 1-4 is a block diagram of the controller logic.

Information exchanged between the processor and the controller includes:

- Data
- DMA transfer control signals
- Status information
- I/O instructions
- Device select signals

Internal processing which must take place within the controller includes:

- Command decoding
- Memory addressing
- Data buffering
- ECC code generation
- Head and sector decoding
- Cylinder/alternate cylinder addressing
- Controller and drive status
- Controller storage registers
- Word and sector counting
- Header, data and sector comparison
- Sync detection
- Seek status detectors

Interface to the disk drives is via the drive cables and the control bus cables. Drivers and receivers control transfer of signals from each drive cable and the control bus to internal controller logic. This information also applies to the LOTUS 730 Multifunction Controller.

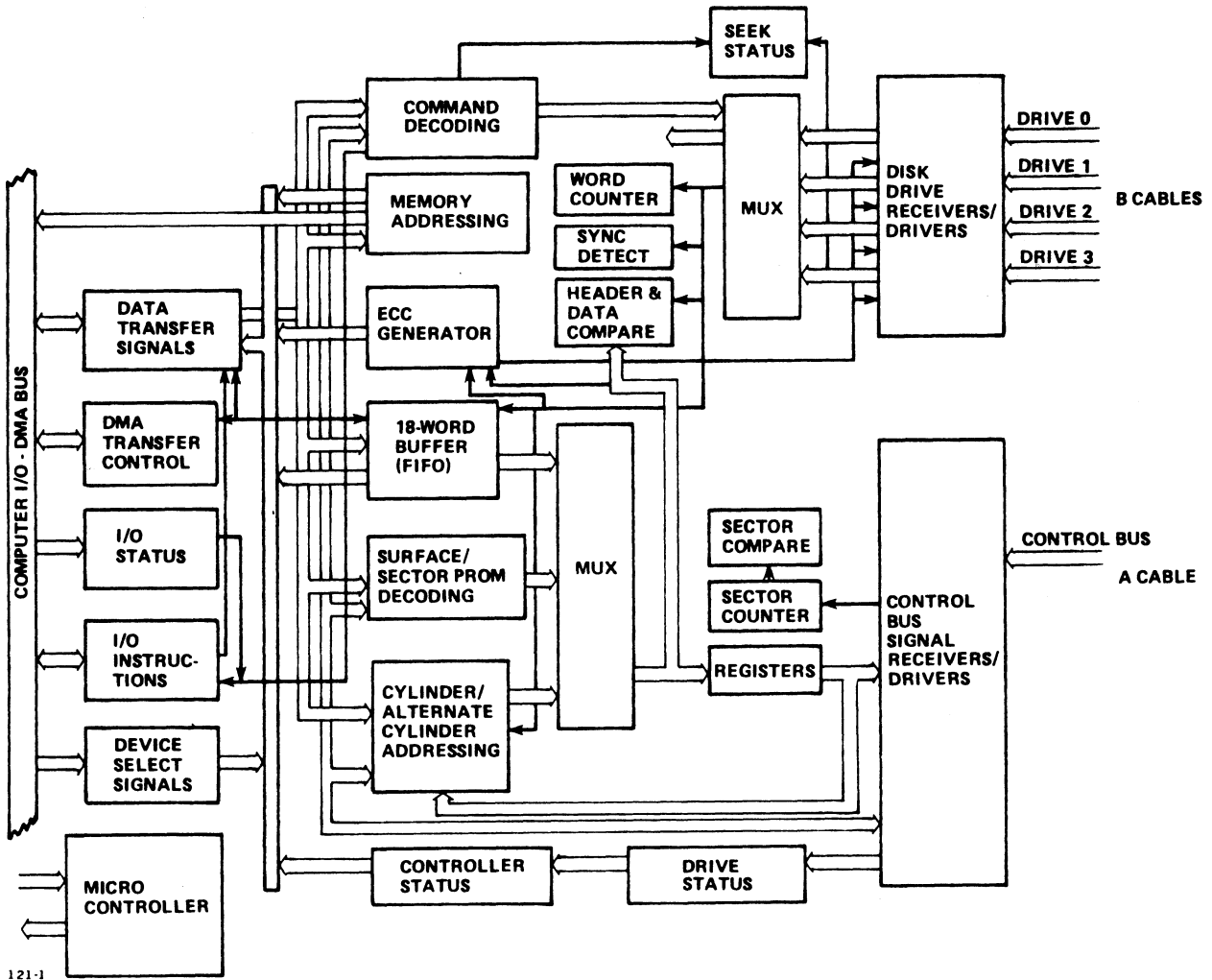


Figure 1-4. LOTUS 710 Disk Controller Block Diagram

1.4.2 LOTUS 720 STREAMING TAPE CONTROLLER ARCHITECTURE

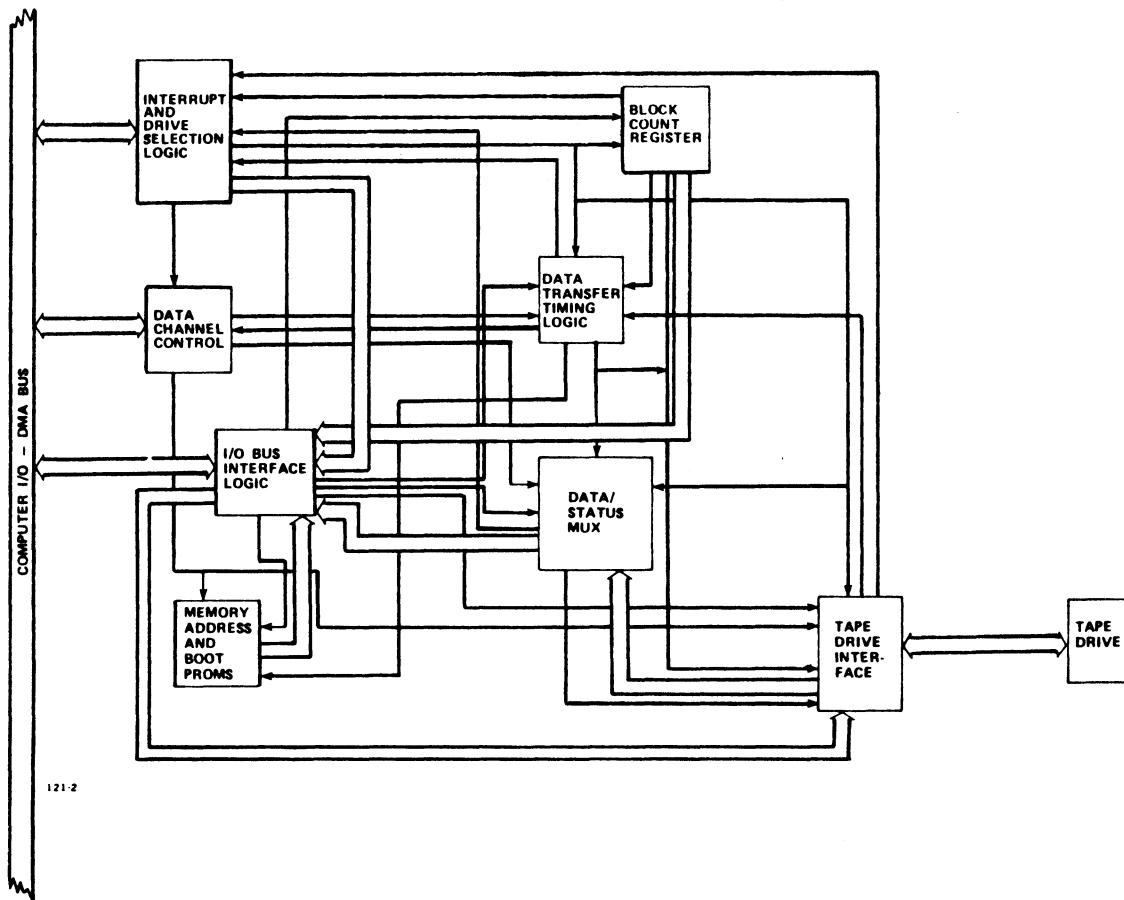
The LOTUS 720 Streaming Tape Controller interfaces a POINT 4 computer and a streaming tape drive. Figure 1-5 is a block diagram of the LOTUS 720 Streaming Tape Controller.

Information transferred between the POINT 4 computer and the LOTUS 720 includes:

- Data
- DMA transfer control signals
- Status information
- I/O instructions
- Device code signals

The LOTUS 720 performs the following internal processes:

- Interrupt generation
- Address, command, and status decoding
- Memory addressing
- Block counting
- Bootstrap operations
- Tape format determination
- ECC generation on write
- ECC error detection on read



121-2

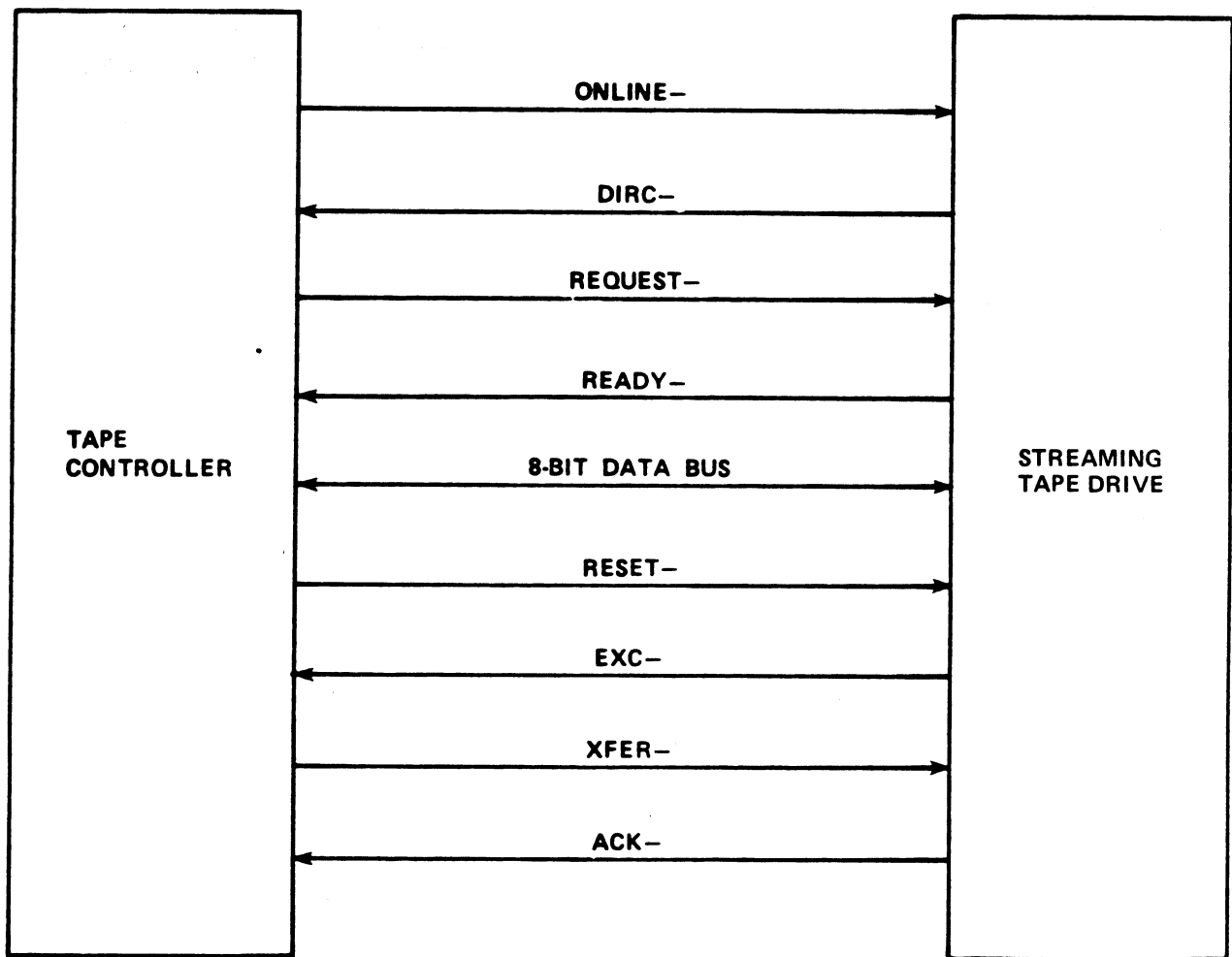
Figure 1-5. LOTUS 720 Streaming Tape Controller Block Diagram

1.5 LOTUS CONTROLLER-TAPE DRIVE INTERFACE

The QIC-02 interface between the LOTUS 720 Streaming Tape Controller and the tape drive(s) consists of:

- Two programmed I/O control lines
- Two programmed I/O status lines
- Two DMA control lines
- 8-bit bidirectional bus
- Reset line

Figure 1-6 illustrates the controller-drive interface signals. Table 1-7 defines the functions of the controller-drive interface signals.



122-7

Figure 1-6. Controller-Drive Interface Signals

TABLE 1-7. CONTROLLER-DRIVE INTERFACE SIGNAL FUNCTIONS

Signal Name	Signal Function
ONLINE-	I/O control line - Set low by the controller before transferring a read or write command; set high to end the read or write command.
DIRC-	Bus-direction line - This signal determines data flow direction. Set low by drive to enable the drive's bidirectional data bus drivers. Set high by drive to place the drive's bidirectional data bus drivers in the high impedance state.
REQUEST-	DMA control line - Set low by controller to indicate that command or status data has been placed on the bidirectional data bus. Set low only when READY- or EXC- are set low.
READY-	<p>Status line - Set low by drive to indicate one of the following conditions:</p> <ul style="list-style-type: none"> ● Data has been received. ● Status data is on the bidirectional data bus. ● Retension, erase, or beginning of tape command has been completed. ● A drive buffer is to be filled or a write file mark (WFM) may be issued. ● A WFM command is complete. ● A drive buffer is ready to be emptied.
HB0- thru HB7-	8-bit bidirectional data bus - HB0- is the least significant bit. HB7- is the most significant bit.

TABLE 1-7. CONTROLLER-DRIVE INTERFACE SIGNAL FUNCTIONS (Cont)

Signal Name	Signal Function
RESET-	Reset line - Set low by controller to initialize drive.
EXC-	Status line - Set low by drive to indicate that an exception (error) condition has occurred.
XFER-	DMA control line - Set low by controller to indicate write data is on the bidirectional data bus or read data has been received.
ACK-	I/O control line. Set low by drive to indicate write data has been received or read data has been transmitted.

Section 2

INSTALLATION

2.1 LOTUS 710 DISK CONTROLLER INSTALLATION AND CABLING

The controller board should be added to the chassis with caution, making sure the card edge connector slides smoothly into the backplane sockets. No backplane wiring is required in a POINT 4 computer chassis.

Cabling between the controller board and the disk drives consists of a control bus daisy-chained between drives, and a separate drive cable to each drive. Cable descriptions are as follows:

<u>Cable</u>	<u>Function</u>	<u>Description</u>
A	Control Bus	30-pair (60-pin) control bus, daisy-chained between drives, terminated at the last drive
B	Drive Cables	26-wire flat cable, radial, one per drive

Connections to the controller are made at the front of the controller board.

One end of the control bus cable mounts at the 60-pin connector on the front of the LOTUS 710 Disk Controller board. The other end mounts to the control bus input connector on the first disk drive. If there is more than one drive on the system, control bus cables must be connected between the output connector on each drive and the input connector on the next drive. The output connector on the last drive must be fitted with a bus terminator.

Drive cables are connected on the LOTUS 710 board to the 26-pin connector adjacent to the control bus connector. The labels, DRIVE 0, DRIVE 1, DRIVE 2, and DRIVE 3, identify the 26-pin B cable connectors. The opposite end of the drive cables connect to the 26-pin drive connectors on each respective drive.

CAUTION

Prevent intermittent errors by performing the following:

1. Connect an AC ground strap between the drives at the AC ground connector and the computer chassis.
2. Isolate each disk drive AC and DC grounds.

Figure 2-1 is an illustration of LOTUS 710 Disk Controller-to-drive cabling.

2.1.1 LOTUS 710 DISK CONTROLLER CABLE INTERFACE SIGNALS

Successful system operation requires both that cabling is properly installed and that cable signals are properly configured. Tables 2-1 and 2-2 list signal configurations of the cables provided with the LOTUS 710 Disk Controller. Check documentation provided with disk drives to be connected to the controller for verification that drive I/O interface signals correspond to control bus and drive cable connector signals.

Connector signal configurations are provided in the following tables:

Table 2-1. Control Bus Signals, A Cable

Table 2-2. Drive Cable Signals, B Cable

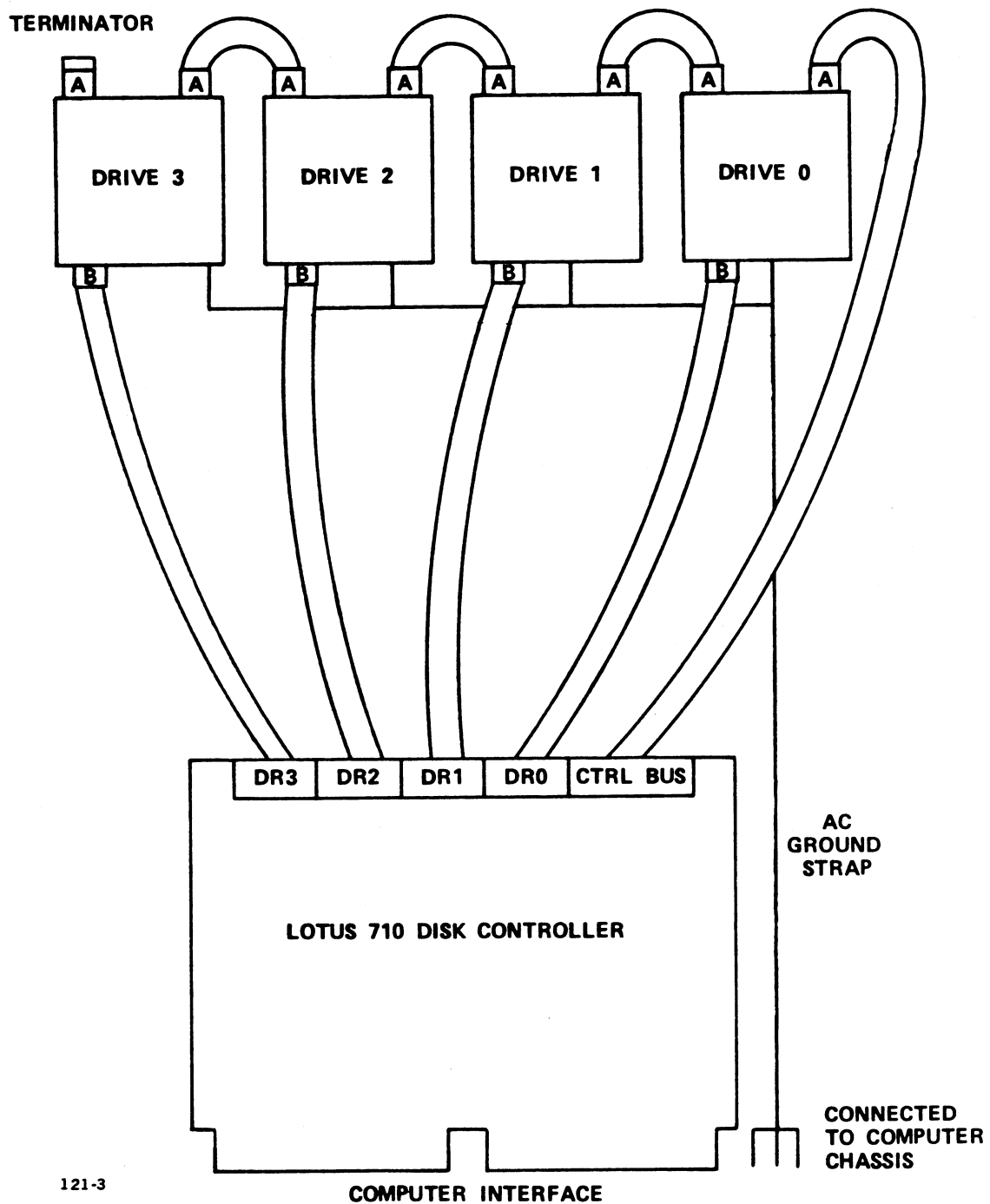


Figure 2-1. LOTUS 710 Disk Controller-to-Drive Cabling

TABLE 2-1. CONTROL BUS SIGNALS - A CABLE

Controller- Drive 60-pin Flat Cable Pin #	Signal Name	Optional 75-pin Trailing Cable (available on some drives) Pin #
1 31	- Tag 1 + Tag 1	46 49
2 32	- Tag 2 + Tag 2	48 51
3 33	- Tag 3 + Tag 3	52 55
4 34	- Bit 0 + Bit 0	23 26
5 35	- Bit 1 + Bit 1	24 27
6 36	- Bit 2 + Bit 2	28 31
7 37	- Bit 3 + Bit 3	29 32
8 38	- Bit 4 + Bit 4	30 33
9 39	- Bit 5 + Bit 5	34 37
10 40	- Bit 6 + Bit 6	35 38
11 41	- Bit 7 + Bit 7	36 39
12 42	- Bit 8 + Bit 8	40 43
13 43	- Bit 9 + Bit 9	41 44
14 44	- Open Cable Detect + Open Cable Detect	16 20
15 45	- Fault + Fault	11 14

TABLE 2-1. CONTROL BUS SIGNALS - A CABLE (Cont)

Controller- Drive 60-pin Flat Cable Pin #	Signal Name	Optional 75-pin Trailing Cable (available on some drives) Pin #
16 46	- Seek Error +	75 78
17 47	- On Cylinder +	15 18
18 48	- Index Mark +	10 13
19 49	- Unit Ready +	17 21
20 50	- (Address Mark Found) +	42 45
21 51	- Unit Reserved (Busy) +	47 50
22 52	- Unit Select Tag +	22 25
23 53	- Unit Select 2 ⁰ +	1 4
24 54	- Unit Select 2 ¹ +	2 5
25 55	- Sector Mark +	74 77
26 56	- Unit Select 2 ² +	3 7
27 57	- Unit Select 2 ³ +	8 12
28 58	- Write Protected +	53 56
29 59	- Pick - Hold	73 76
30 60	- Spare +	54 57

TABLE 2-2. DRIVE CABLE SIGNALS - B CABLE

Controller- Drive 26-pin Flat Cable Pin #	Signal Name	Optional 32-pin Trailing Cable Pin #
1	Ground	K
14 2	+ Servo Clock -	N M
15	Ground	T
3 16	- Read Data +	U V
4	Ground	Y
17 5	+ Read Clock -	X W
18	Ground	E
6 19	- Write Clock +	H J
7	Ground	D
20 8	+ Write Data -	B A
21	Ground	C
9 22	+ Unit Selected -	BB DD
10 23	- Seek End +	AA CC
11	Ground	LL
24 12	+ (Index Mark)* -	HH EE
25	Ground	NN
13 26	- (Sector Mark)* +	FF JJ
<p>*Not used on this cable. POINT 4 equipment uses Index Mark and Sector Mark signals on the A cable.</p>		

2.1.2 LOTUS 710 DISK CONTROLLER JUMPERS

The LOTUS 710 Disk Controller allows jumper selection of the following features:

- Device addressing
- Mask bit

Table 2-3 lists jumper information.

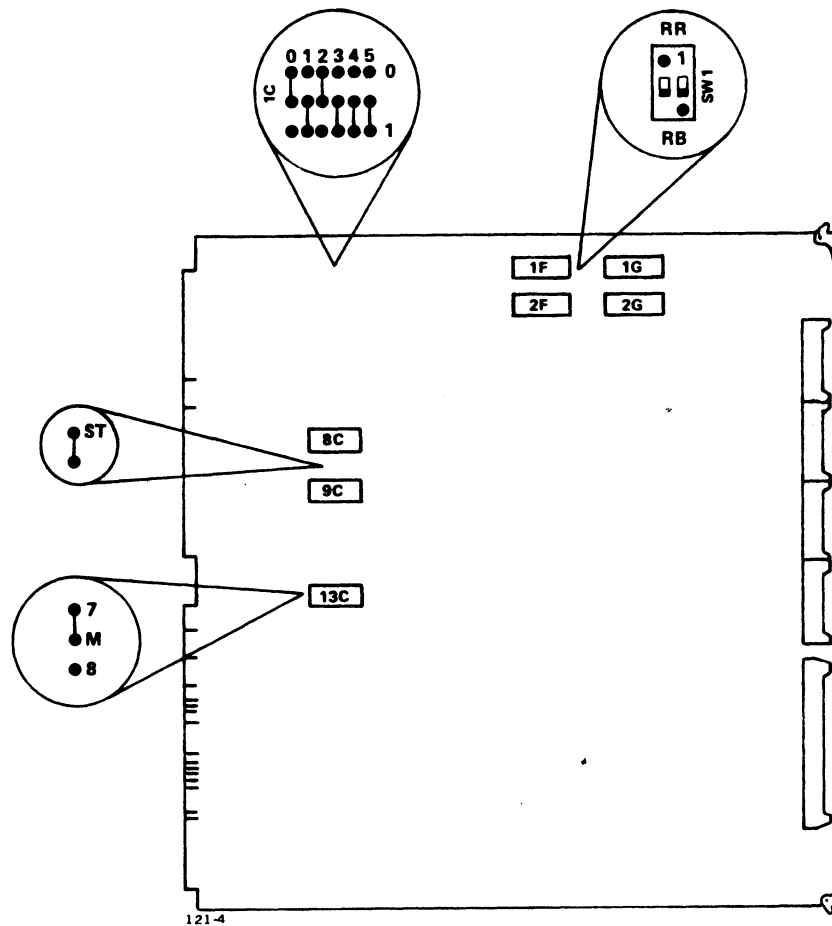
Figure 2-2 illustrates jumper locations and factory-installed jumper positions.

TABLE 2-3. LOTUS 710 DISK CONTROLLER JUMPER INFORMATION

Feature Name	Jumper Location	Jumper Description
Device address	1C	Factory installed for 27 (octal) Jumper installed = 0 Open = 1
Mask bit	13B	Factory installed for 7 Can be set for 8
Automatic retry	9C	Factory installed to enable retry; remove jumper to disable retry

2.1.3 LOTUS 710 DISK CONTROLLER READ REGARDLESS SWITCH

The read regardless operation causes an unedited track read. The controller transfers all words in a sector to the CPU memory. Set the read buffer switch to the RR position to enable read regardless operation. POINT 4 normally sets the switch to the RB position.



**Figure 2-2. LOTUS 710 Disk Controller
Jumper Locations**

2.1.4 LOTUS 710 HEAD AND SECTOR PROMS

The LOTUS 710 Disk Controller features flexibility in system configuration by allowing any mixture of compatible drives to be attached to a controller. This flexibility is made possible through the use of two configuration PROMs which must be programmed with control information for the attached drives.

The Head (surface) PROM (22C on the 710 board) and the Sector PROM (19C on the 710 board) provide information within the controller about the type and size of the attached drives. These PROMs flag illegal surface and/or illegal sector numbers supplied by the CPU for data transfer operations. They also provide information on sector and/or surface overflow in multisector transfers.

All LOTUS 710 Disk Controllers ordered from POINT 4 Data Corporation will require submission of disk drive type information. POINT 4 uses this information to program the head and sector PROMs.

Table 2-4 lists disk drive types and the corresponding PROM codes. Reference the IRIS R8 Peripherals Handbook for additional information.

**TABLE 2-4. LOTUS 710 HEAD SELECT PROM GUIDE
(DRIVES SUPPORTED UNDER IRIS 8.2)**

Drive	PROM Code	No. of Heads (Decimal)	Size (MB)	Type
Ampex DFR-932	F	2	32	CMD
Ampex DFR-964	F	4	64	CMD
Ampex DFR-996	F	6	96	CMD
Ampex DM-940	E	5	40	SMD
Ampex DM-980	E	5	80	SMD
Ampex DM-9160	E	5	160	SMD
Ampex DM-9300	S	19	300	SMD
Ball BD-80	E	5	80	SMD
CDC 9448-32	F	2	32	CMD
CDC 9448-64	F	4	64	CMD
CDC 9448-96	F	6	96	CMD
CDC 9455 (Lark)	4	4	16	LMD
CDC 9457 (Lark 2)	4	4	50	LMD
CDC 9710	E	5	80	SMD
CDC 9715	J	10	168	SMD
CDC 9760	E	5	40	SMD
CDC 9762	E	5	80	SMD
CDC 9766	S	19	300	SMD
Century Data T-82	E	5	80	SMD
Century Data T-302	S	19	300	SMD
Century Data T-306	S	19	300	SMD
Fujitsu M-2283	H	8	135	SMD
Fujitsu M-2284	J	10	168	SMD
Fujitsu M-2294	P	16	335.5	SMD
Fujitsu M-2312K	G	7	84	SMD
Fujitsu M-2322K	J	10	168	SMD
Priam 3450	E	5	35	SMD
Priam 7050	E	5	70	SMD
Priam 3350	C	3	34	SMD
Priam 6650	C	3	68	SMD

2.2 LOTUS 720 STREAMING TAPE CONTROLLER

The LOTUS 720 Streaming Tape Controller is a single printed circuit board that occupies any one I/O slot in the POINT 4 Computer chassis. Install the LOTUS 720 Streaming Tape Controller in the chassis with care. Make sure the card edge connector slides smoothly into the backplane sockets. No backplane wiring is required for installation in a POINT 4 Computer chassis. Cable connection to the LOTUS 720 Streaming Tape Controller is provided by a 50-pin connector at the front of the printed circuit board. Only one streaming tape drive can be connected directly to the LOTUS 720 Streaming Tape Controller. Connection of additional streaming tape drives is accomplished by daisy-chaining from the drive directly connected to the controller. Refer to tape drive documentation for further information on daisy-chaining of streaming tape drives. Table 2-5 lists connector pin numbers and corresponding signal names.

**TABLE 2-5. LOTUS 720 STREAMING TAPE CONTROLLER
SIGNAL-CONNECTOR PIN CHART**

Pl Pin Number*	Signal Name	Pl Pin Number*	Signal Name
12	HB7-	28	ONLINE-
14	HB6-	30	REQUEST-
16	HB5-	32	RESET-
18	HB4-	34	XFER-
20	HB3-	36	ACK-
22	HB2-	38	READY-
24	HB1-	40	EXC-
26	HB0-	42	DIRC-

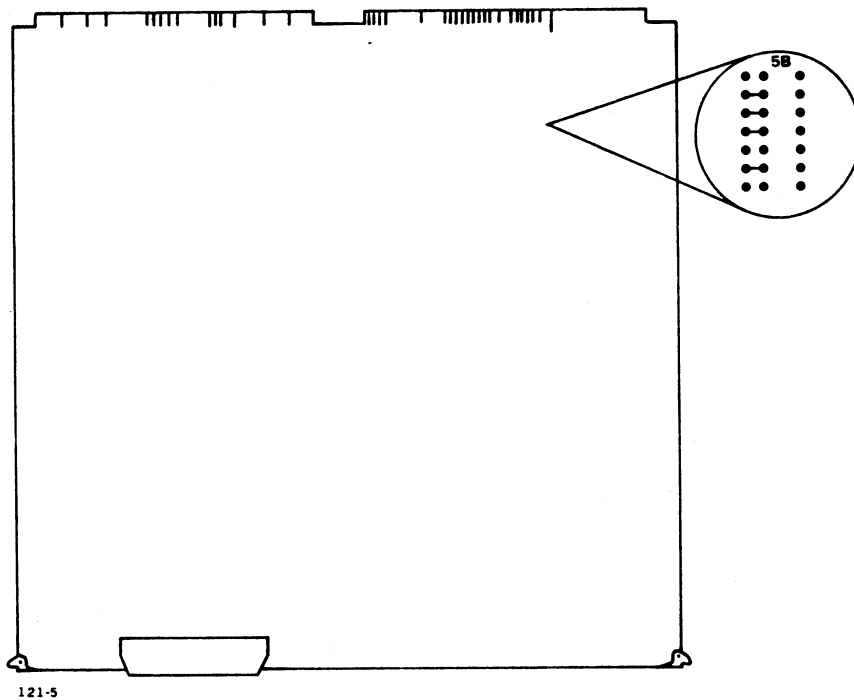
*Pins 02, 04, 06, 08, 10, 44, 46, 48, and 50 are spare signal lines and are not used. All odd numbered pins are signal returns and should be connected to ground. Signals are terminated with 220 ohms to +5V and 330 ohms to ground.

The device address for the LOTUS 720 Streaming Tape Controller is established by etches on the printed circuit board at location 5B. The etches on the LOTUS 720 Streaming Tape Controller are set for a device code of 42. To change the device address, cut existing etches. Next, install jumpers as required for the new octal device address.

NOTE

Connect a select-disable jumper if the LOTUS 720 Streaming Tape Controller is to be disabled. For address selection, installed jumpers provide a zero. Uninstalled jumpers provide a one.

Figure 2-3 illustrates the device address and the select-disable etches.



**Figure 2-3. LOTUS 720 Streaming Tape Controller Device
Address and Select Disable Etch Location**

2.3 LOTUS 730 MULTIFUNCTION CONTROLLER INSTALLATION AND CABLING

Installation and cabling information for the LOTUS 730 Multifunction Controller is identical to installation and cabling information for the other LOTUS controllers. However, connector locations are slightly different. Figure 2-4 illustrates the LOTUS 730 Multifunction Controller-to-drive cabling. Reference Sections 2.1 and 2.2 for installation and cabling information.

2.3.1 LOTUS 730 MULTIFUNCTION CONTROLLER CABLE INTERFACE SIGNALS

LOTUS 730 Multifunction Controller interface signals are identical to the LOTUS 710 Disk Controller and LOTUS 720 Streaming Tape Controller interface signals. Reference Sections 2.1.1 and 2.2 for cable interface signal information.

2.3.2 LOTUS 730 MULTIFUNCTION CONTROLLER JUMPERS

The LOTUS 730 Multifunction Controller allows jumper selection of the following features:

- Device addressing
- Controller disable
- Done after seek
- Extended cylinder and head addressing

Table 2-6 lists jumper information. Figure 2-5 illustrates the jumper locations on the LOTUS 730 Multifunction Controller.

NOTE

The LOTUS 730 Multifunction Controller does not allow jumper selection of the mask bit.

2.3.3 LOTUS 730 MULTIFUNCTION CONTROLLER READ BUFFER SWITCH

The read regardless operation causes an unedited track read. The controller transfers all words in a sector to the CPU memory. Set the read buffer switch to the READ REG position to enable read regardless operation. POINT 4 sets the read buffer switch to the NORMAL position.

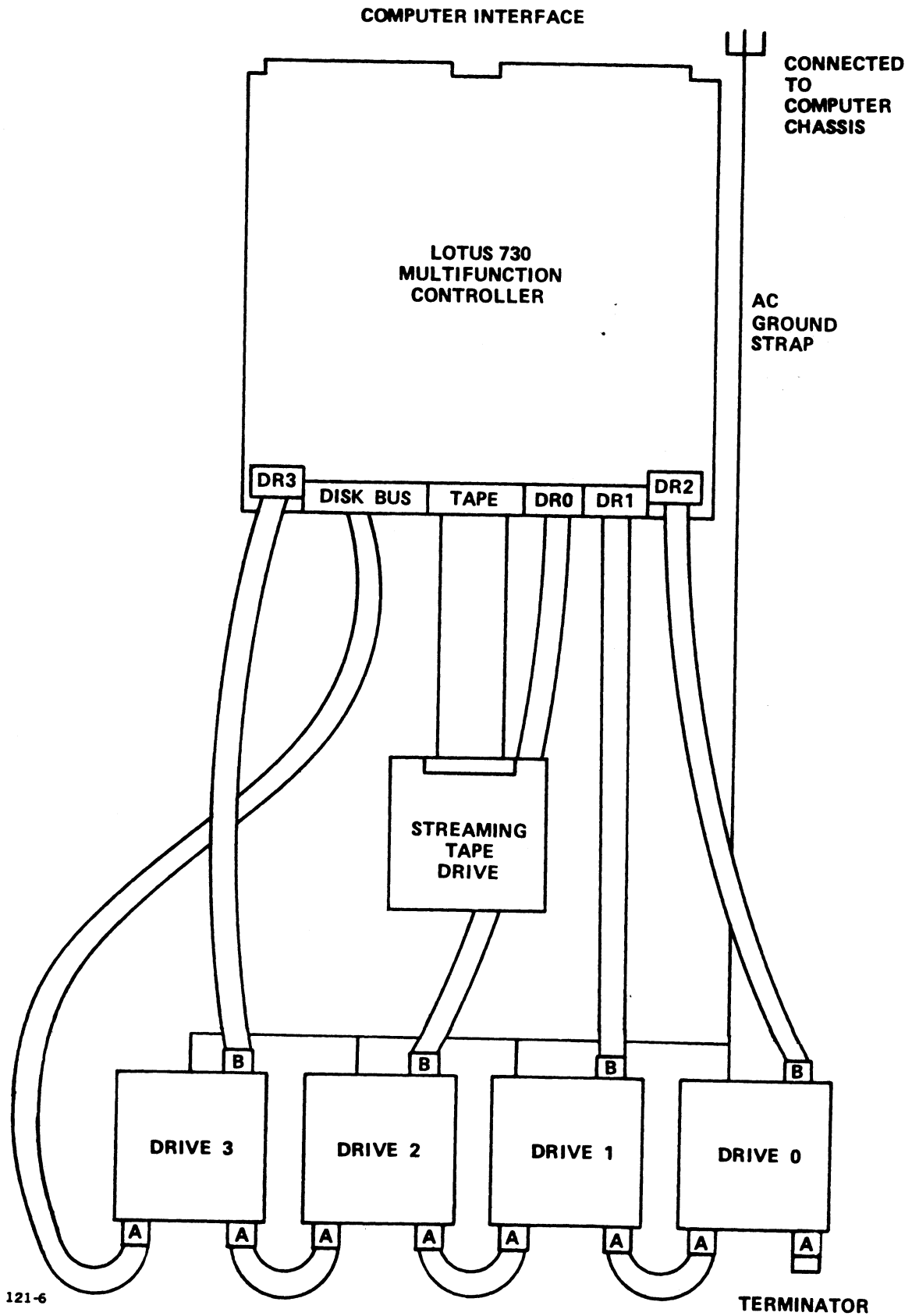
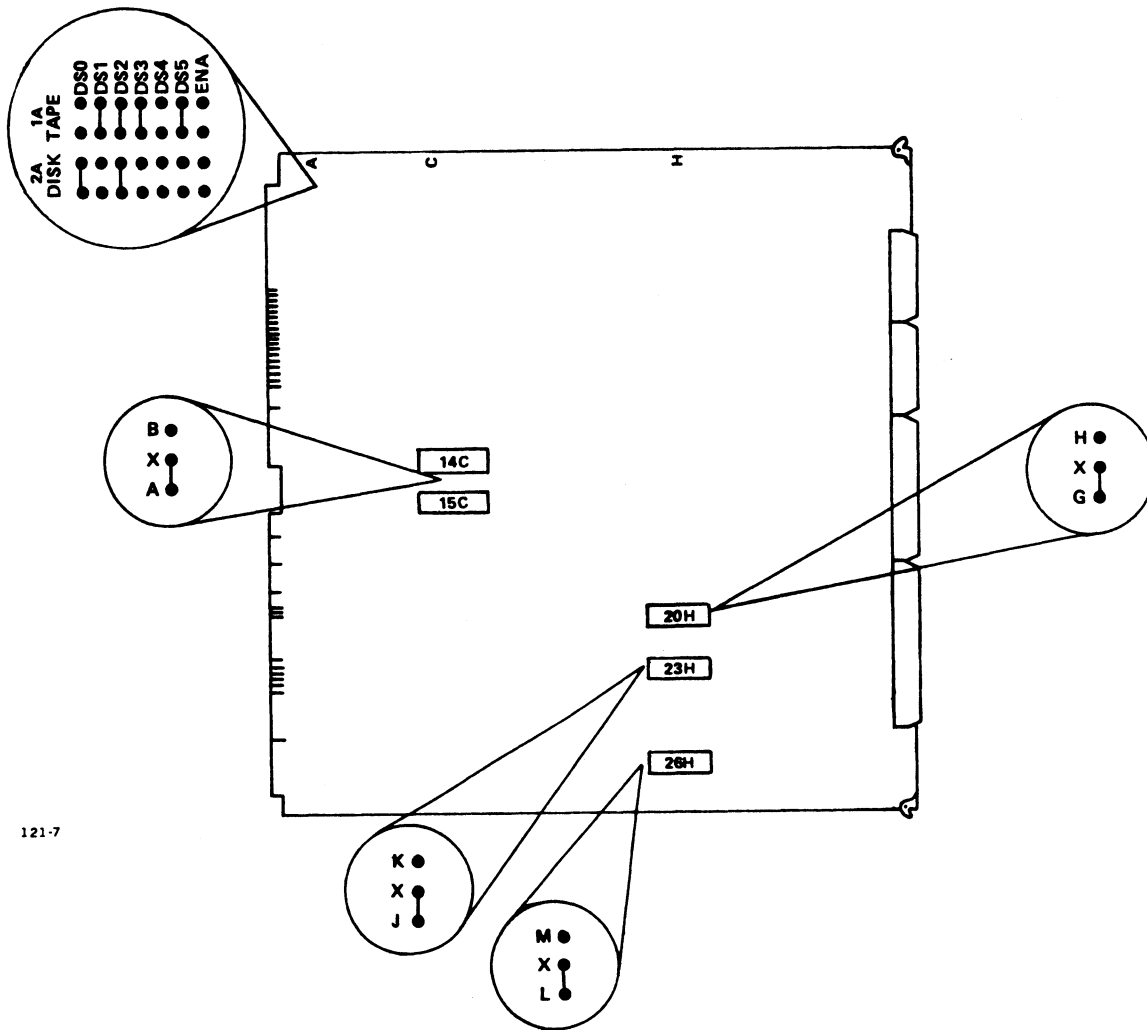


Figure 2-4. LOTUS 730 Multifunction Controller-to-Drive Cabling

**TABLE 2-6. LOTUS 730 MULTIFUNCTION CONTROLLER
JUMPER INFORMATION**

Feature Name	Jumper Location	Jumper Description
Device Address	1A (tape controller) 2A (disk controller)	Factory installed for 42 (octal) Jumper installed = 0; Open = 1 Factory installed for 27 (octal) Jumper installed = 0; Open = 1
Controller Disable	1A (tape controller) 2A (disk controller)	Open - enables tape controller Jumpered - disables tape controller Open - enables disk controller Jumpered - disables disk controller
Done After Seek	Between 14C and 15C	Factory installed in AX position. Sets Done flag and generates interrupt after a seek operation. Jumper to BX position to prevent setting Done flag after seek operation. Interrupt generated after seek operation.
Extended Cylinder Address Error	20H	Factory installed in GX position. Used for cylinder extended addressing in LOTUS 730 mode. Jumper to HX position for LOTUS 710 addressing.
Extended Cylinder Addressing	23H	Factory installed in JX position to enable extended cylinder address bit. Jumper to KX position to disable extended cylinder address bit for LOTUS 710 addressing.
Extended Head Addressing	26H	Factory installed in LX position for extended head addressing. Jumper to MX position for LOTUS 710 head addressing.



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Figure 2-5. LOTUS 730 Multifunction Controller Jumper Locations

2.3.4 LOTUS 730 MULTIFUNCTION CONTROLLER DRIVE AND SECTOR SELECTION SWITCHES

Programming head and sector PROMs is unnecessary with the LOTUS 730 Multifunction Controller. The head PROM (location 20G) contains information about drive types. The drive selection switches (locations 14L, 12L, 10L and 17L) select the proper information in the head PROM. The sector switches (locations 14L, 12L, 10L, and 17L) allow users to select the number of sectors on a disk. Table 2-7 presents information on drive types and switch settings for the standard PROM.

TABLE 2-7. LOTUS 730 MULTIFUNCTION CONTROLLER DRIVE AND SECTOR SELECTION SWITCH SETTINGS

Drive Types	Switches*			Drive Examples
	1	2	3	
1 + 5 Heads	OFF	OFF	OFF	CMD drives: CDC 9448 series; Ampex DFR series
4 Heads	ON	OFF	OFF	Lark-type drives: CDC 9455-Lark; CDC 9457-Lark 2; Amcodyne Arapahoe
5 Heads	OFF	ON	OFF	Common 80MB drives: Priam 3450-35MB; Priam 7050-70MB; Ampex DM-940, 980, 9160; Ball BD80; CDC SMD-9760, 9762; CDC RSD-9710; Century Data T52, T82
7 Heads	ON	ON	OFF	Fujitsu 2312 (84MB)
10 Heads	OFF	OFF	ON	Fujitsu 2322, 2284 (each 168MB); CDC 9715-FSD
19 Heads	ON	OFF	ON	Common 300MB drives: Ampex DM-9300; CDC SMD-9766; Century Data T302, T306
32 Heads	OFF	ON	ON	All drives (excluding CMD) up to 32 heads
64 Heads	ON	ON	ON	All drives (excluding CMD) up to 64 heads
Sector Selection	Switches*			
	4	5		
32	OFF	OFF		
24	ON	OFF		
-	OFF	ON	Reserved	
22	ON	ON		
*Switch 6 is not used.				

2.4 TESTING

POINT 4 Data Corporation recommends running diagnostics after installation of a LOTUS controller. Before running diagnostics, check the following items:

- All jumpers - particularly any changes from the factory installed positions
- Read buffer switch setting on disk controllers
- Drive selection switch settings on LOTUS 730 Multifunction Controller
- Controller installation in chassis
- Cabling and drive connections

Section 3

OPERATING PROCEDURES

3.1 INTRODUCTION

This section is for use by assembly language programmers, installation/maintenance personnel, and non-IRIS users. Most IRIS users find the operation procedures and information in the IRIS R8 Operations Manual, IRIS R8 Installation and Configuration Manual, and IRIS R8 Peripherals Handbook adequate for their purposes. Appendix A contains information about POINT 4 software supplied on streaming tape.

3.1.1 DISK CONTROLLER OPERATION

The computer uses I/O instructions to transfer information between the processor's general-purpose 16-bit accumulators and the LOTUS 710 Disk Controller or the LOTUS 730 Multifunction Controller. Information transferred may be commands, computer memory addresses, disk addresses, disk controller or disk drive status, or error correction code remainder (ECCR) codes. From this information, the disk controller initiates seeks, receives status, reads data from the drive, and writes data to the disk drive.

The LOTUS 710 Disk Controller's addressing capacity per drive is 1024 tracks, 32 surfaces, and 32 sectors. The LOTUS 730 Multifunction Controller's addressing capacity per drive is 2048 tracks, 64 surfaces, and 32 sectors. Each sector contains 512 bytes of data. Up to 32 consecutive sectors may be transferred per operation with the cylinder boundary being crossed if necessary.

Bad Sector and Alternate Sector flags are provided to point out sectors known to be faulty. These flags are set during disk formatting. If the Alternate Sector flag is set, the alternate sector address is specified in the sector header. Alternate sectoring is done automatically requiring no program intervention.

Overlapped seek allows simultaneous seek and data transfers on multidrive systems. Once a seek command has been issued to the drive, the LOTUS 710 Disk Controller is ready to accept another command from the CPU. When the data transfer command is completed, a program-interrupt request is issued to alert the CPU that the transfer is complete.

A jumper on the LOTUS 730 controls the setting of the Done flag after a seek operation. Table 2-6 describes this jumper.

Additional features include a 32-bit ECCR error detection code for read or write operations. Error correction is programmable. In addition, system flexibility is increased by use of a programmable device code.

The LOTUS 710 Disk Controller provides an efficient handling of LMD-type drives such as the CDC 9455/9457 (Lark). Previously, the seek-after-head-change option had to be enabled on a Lark drive. Enabling this option resulted in more overhead because an extra on-track seek was required for every head change.

With the LOTUS 710 Disk Controller, remove the seek-after-head-change option from the Lark drive. Instead, a software change is required to allow the specification of a head number before issuing a seek command. The result is a significant improvement in Lark performance.

NOTE

Removal of the Lark seek-after-head-change option is unnecessary with the LOTUS 730 Multifunction Controller.

3.1.2 TAPE CONTROLLER OPERATION

The computer uses I/O instructions to transfer information between the processor's general-purpose 16-bit accumulators and the LOTUS 720 Streaming Tape Controller or the LOTUS 730 Multifunction Controller. Information transferred may be commands, computer memory addresses, block counts, controller or drive status or four error correction code (ECC) bytes. From this information, the tape controller initiates tape motions, receives read data from the drive, and sends write data to the tape drive.

The tape controller transfers up to 256 data blocks in a read or write operation. Each block contains 256 words.

3.2 DISK FORMATTING

Before data transfer operations can take place the surfaces on the disk must be formatted. Formatting records a unique header at the beginning of each sector on the disk. This header contains the information necessary to identify each sector. Figure 3-1 represents the configuration of a LOTUS 710 formatted sector. Figure 3-2 represents the configuration of a LOTUS 730 formatted sector.

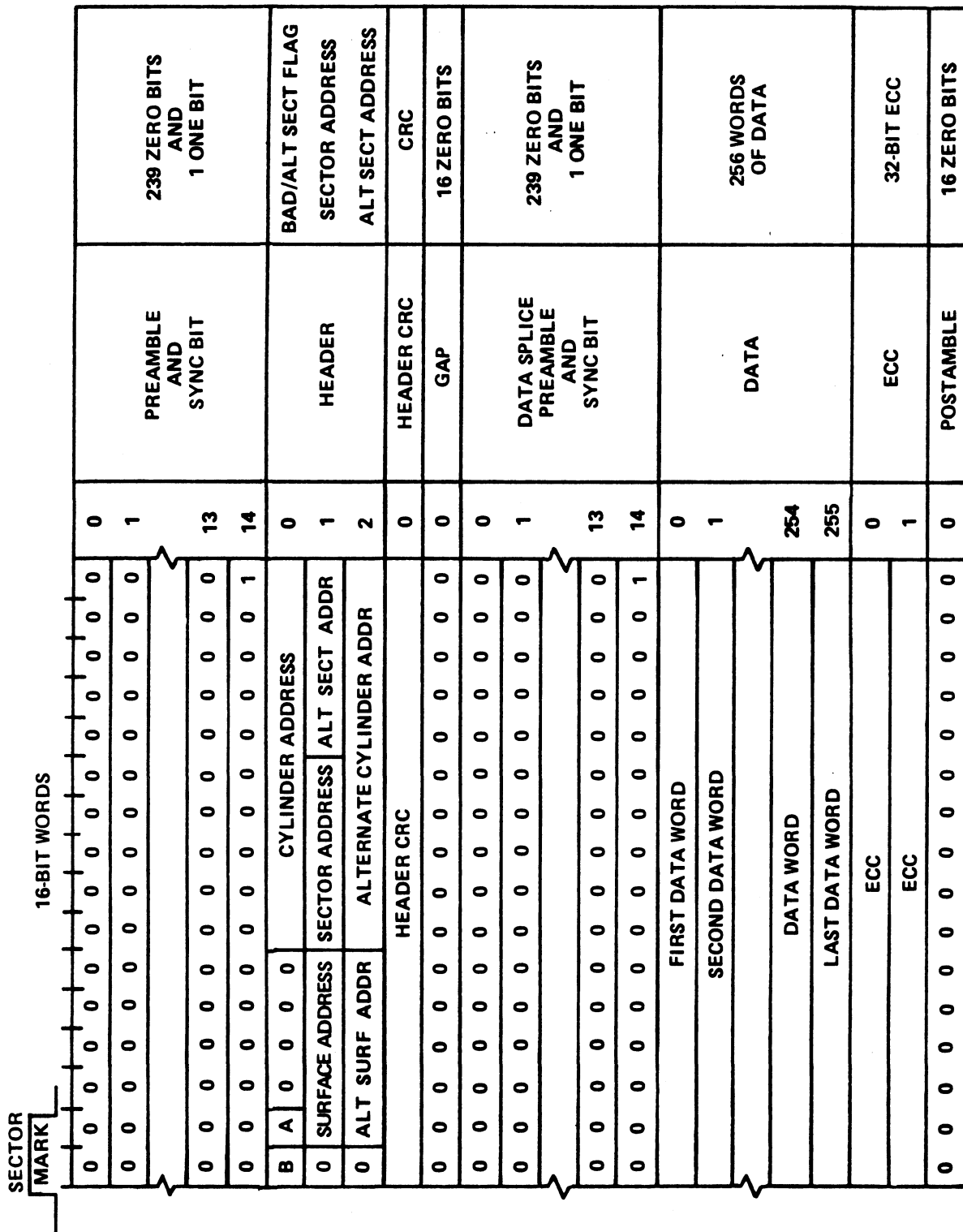
3.2.1 SECTOR FORMAT

The formatted sector contains:

- 30 bytes of preamble and sync bit
- 6 bytes of header information
- 2 bytes of header cyclic redundancy code (CRC)
- 2 bytes of gap
- 30 bytes of data splice preamble and sync bit
- 512 bytes of data storage
- 4 bytes of ECC
- 2 bytes of postamble

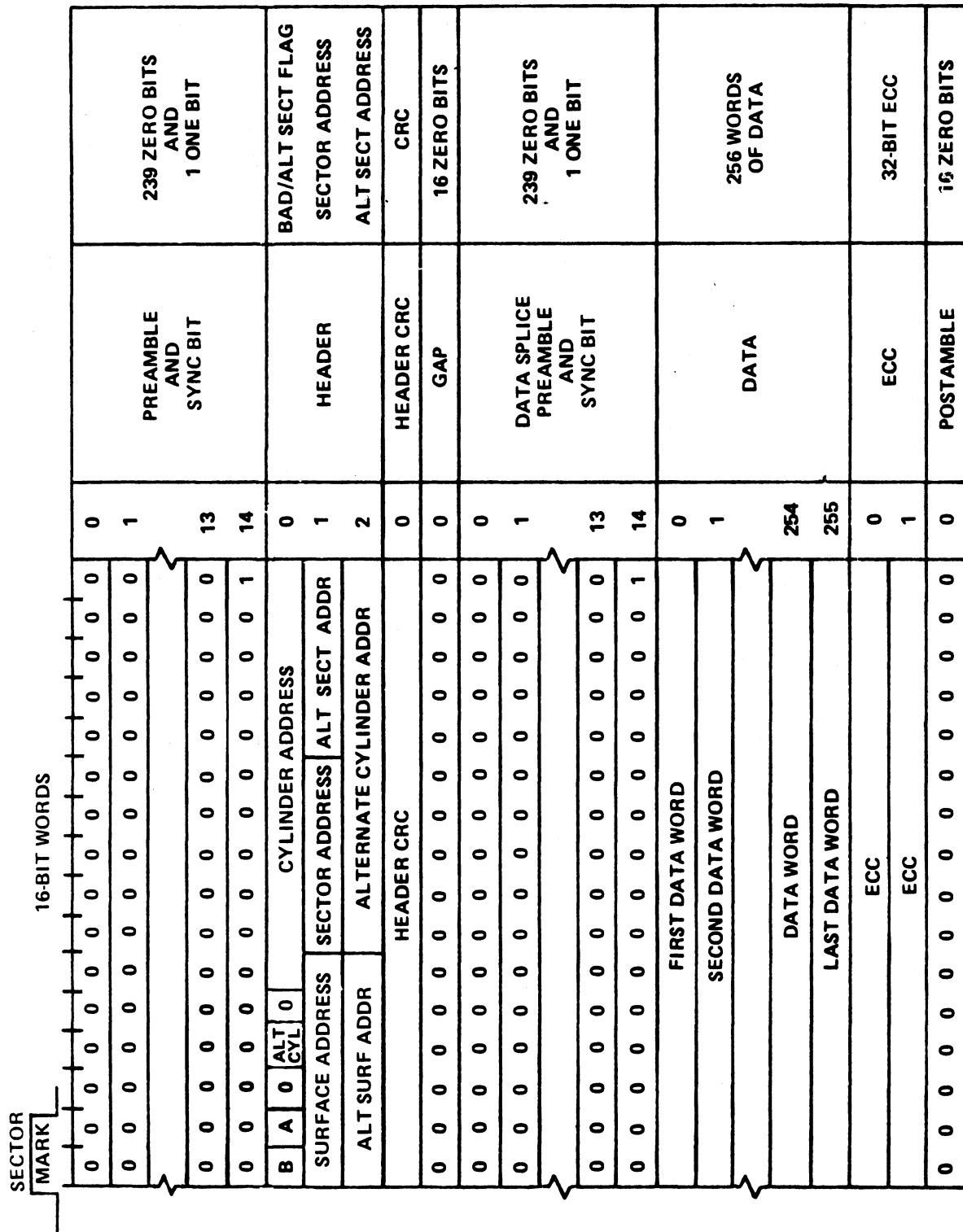
The six bytes of header information contain address information used by the controller to locate the desired sector for a data transfer operation. The LOTUS 710 Disk Controller cylinder address occupies 10 bits of the first word of the header. The LOTUS 730 Multifunction Controller uses 11 bits. The first word of the header also contains a Bad Sector flag and an Alternate Sector flag of one bit each. Surface address (five bits for LOTUS 710; six bits for LOTUS 730), sector address (five bits) and alternate sector address (five bits) occupy the second word of the header. Word three of the header contains a 5-bit alternate surface address (six bits for LOTUS 730) and a 10-bit alternate cylinder address (11 bits for LOTUS 730). The header is completed by a word of CRC that ensures error-free reading of the header.

If a sector cannot support error-free data, the format/surface analysis program sets the Bad Sector flag or the Alternate Sector flag. If the Bad Sector flag is set to one, operation will be terminated. If the Alternate Sector flag is set to one, an alternate sector address is provided.



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Figure 3-1. Configuration of a LOTUS 710 Disk Controller Formatted Sector



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Figure 3-2. Configuration of a LOTUS 730 Multifunction Controller Formatted Sector

3.2.2 FORMAT OPERATION

The format command causes complete reformatting of the sector(s) specified. Header information is provided from the controller's address register. When a sector is formatted, all data in that sector is lost (the sector data bytes are filled with zeros).

The Write Header command is provided to set flags, write alternate sector address, or provide for interleaving of sectors. The Write Header command uses three words from computer memory as a source of header information. This command does not destroy the data in that sector.

For data transfer commands the controller reads the sector headers passing under the selected disk drive head. It checks flags, address and CRC.

- A CRC error causes a retry on the next header.
- A cylinder/surface address error terminates the operation by setting the respective error flags.

If the cylinder, surface and sector address match,

- A Bad Sector flag terminates the operation.
- An Alternate Sector flag causes the controller to find the sector designated by the alternate-sector address.

If neither flag is set, data transfer commences. See Figure 3-3 for a flowchart of this operation.

For format, write-header, and read-format operations, the controller synchronizes to the index mark, then counts the sector marks to find the desired sector.

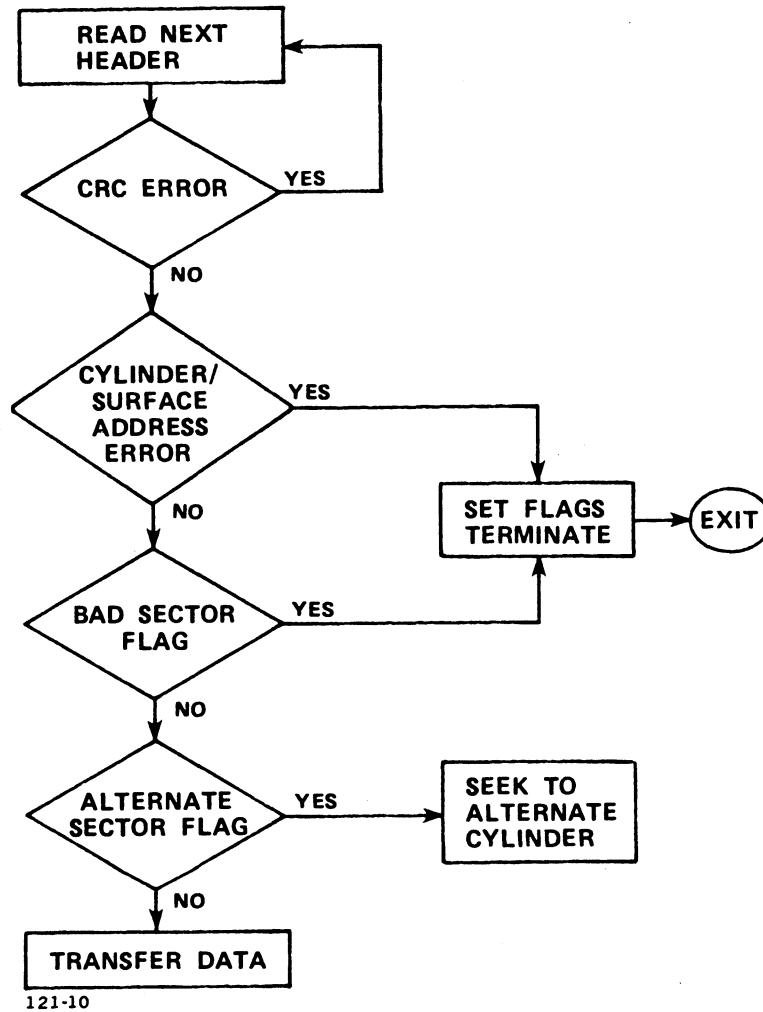


Figure 3-3. Format Operation Flowchart

3.3 DISK DRIVE-TO-CONTROLLER DATA TRANSFER PROGRAMMING

Execution of a data transfer between the disk and memory requires use of a series of commands to ensure that all information necessary for the transfer has been conveyed to all devices involved. Activities involved in a data transfer include:

- Drive selection
- Status checks on that drive and the controller
- Drive head positioning
- Issuing of a read or write command
- Specification of disk surface and sector address
- Specification of the memory address for data transfer
- Start operation

3.3.1 DISK DRIVE COMMAND OPERATION PROCEDURE

Drive commands are: recalibrate, seek, trespass and release. All may be programmed using the following procedure:

1. Check the controller status by issuing a DIA - Read Controller Status instruction. In order to proceed, the controller status transferred to the processor accumulator must contain the Controller Full flag (bit 0) set to zero, indicating that the previous drive command has been transmitted to that drive. If the Controller Full flag is set to one, all DOA instructions will be ignored.
2. Select the drive and specify the drive command by issuing a DOA - Specify Command and Drive instruction. The processor accumulator should contain the drive number in bits 9 and 10. This information will be transferred to the controller's drive select register. Bits 5 through 8 of the accumulator should contain the drive command to be transferred to the controller's command register.
3. Read the disk drive status by issuing a DIB - Read Drive Status instruction. The drive status information transferred from the controller indicates whether the drive is ready; whether the drive is reserved by the other processor in the system (if any); whether any drive faults exist; and whether the drive is busy with a previous drive command. The drive will reject all commands if it is not ready, is busy, or has been reserved by the other processor.
4. The desired cylinder number is specified by issuing a DOCP - Specify Cylinder instruction. The P (pulse) control function sets the Controller Full flag to one and initiates the command transfer to the drive. Once the command is transferred to the drive, the Controller Full flag is cleared. Completion of the command sets the Drive Done flag to one, causing an interrupt to the controller (if the Controller Busy flag is not set to one). If the drive is not ready, is busy or has been reserved for the other processor when the DOCP instruction is issued, the command will be rejected by setting the Drive Done flag to one and clearing the Controller Full flag to zero.

NOTE

Trespass and Recalibrate commands are issued similarly.

3.3.2 DISK-TO-CONTROLLER DATA TRANSFER PROCEDURE

Read/write commands can be issued without waiting for the completion of the seek operation. Once the seek operation has been initiated, proceed to program data transfer as follows:

1. Check the Controller Busy flag by issuing a Skip If Busy Flag Is Nonzero I/O instruction. Verify that no data transfer is in progress (Busy = 0). No new data transfer may be initiated if the previous data transfer is still in progress.
2. Check controller status by issuing a DIA - Read Controller Status instruction. In order to proceed, the controller status transferred to the processor accumulator must contain the Controller Full flag (bit 0) set to zero, indicating that the previous drive command has been transmitted to that drive. If the Controller Full flag is set to one, all DOA instructions will be ignored.
3. Select the drive and specify a Read/Write (or Verify) command by issuing a DOA - Specify Command and Drive instruction. The processor accumulator should contain the drive number in bits 9 and 10. This information will be transferred to the controller's drive-select register. Bits 5 through 8 of the accumulator should contain a Read/Write or Verify command (0000/1110 or 1100) to be transferred to the controller's command register.
4. Read the disk drive status by issuing a DIB - Read Drive Status instruction. Check the status to verify that the disk drive is ready, and that there is no drive fault. For a write operation, that drive must not be write-protected.
5. The desired starting surface, sector address and sector count is specified by issuing a DOC - Specify Surface, Sector and Sector Count instruction. For the LOTUS 710 Disk Controller, bits 1-5 of the processor accumulator should contain the surface address to be transferred to the controller's surface-address register. For the LOTUS 730 Multifunction Controller, bits 2-5 of the processor accumulator should contain the surface address to be transferred to the controller's surface-address register. Bits 6-10 of the accumulator should contain the sector address to be transferred to the controller's sector-address register. Bits 11-15 of the accumulator should contain the sector count to be transferred into the controller's sector-count register.
6. Issue a DOBS to specify the memory address to be used in the first DMA transfer. The S (start) control function sets the Device Busy flag to one, clears the Device Done flag to zero, starts the one-second read/write timeout timer and initiates the data transfer operation.

The controller finds the desired sector on the specified surface and performs the data transfer between memory and the disk drive. Data transfer continues until sector count overflows, at which time transfer operation terminates. Termination of data transfer causes Busy to clear to zero, sets the Device Done to one, and generates an interrupt to the processor. If the data transfer is not completed in one second, the operation is terminated.

3.4 TAPE DRIVE-TO-CONTROLLER DATA TRANSFER PROGRAMMING

Execution of a data transfer between the tape drive and memory requires use of a series of commands to ensure that all information necessary for the transfer has been conveyed to all devices involved. Activities involved in a data transfer include:

- Drive selection
- Status checks on drive and controller
- Tape positioning
- Issuing of a read or write command

Reference Appendix B for bootstrap operation information.

3.4.1 WRITE DATA TRANSFER PROCEDURE

To program write-data operations, proceed as follows:

1. Execute a DIA instruction to read the controller status. Verify that the exception (EXC) flag is not set, and the Ready flag is set.
2. Execute a DOAS instruction to select the drive.
3. Execute a DOA instruction to read the tape status (see read status procedure, Section 3.4.3). Verify that the cartridge is in the tape drive and that it is not write-protected. If the beginning of tape (BOT) flag is set, go to step 5.
4. Execute a DOAS instruction to rewind the tape to BOT.
5. Execute a DOA instruction to set the On-line flag and to specify a write command.
6. Execute a DOB instruction to specify the starting memory address.
7. Execute a DOCS instruction to specify the block count, and to start the operation.

If the EXC flag is not set, a Write command may be followed only by a Write or Write File Mark command.

A file mark is a unique data block created by the drive. The command may be given in one of two ways:

- A file mark may be written by executing a DOAS instruction with a Write File Mark command. The drive will write a file mark, stop tape motion and exit write mode. The drive will not rewind the cartridge.

- If the On-line flag is reset at any time during write/write-file-mark operation, the streaming tape drive then writes a file mark and rewinds the tape to BOT. This effectively terminates the write operation.

Encountering the end of tape (EOT) marker will set EXC and the EOT bit in the first status byte. It is possible to write two blocks of data and a file mark after EOT detection.

3.4.2 READ DATA TRANSFER PROCEDURE

To program read-data operations, proceed as follows:

1. Execute a DIA instruction to read the controller status. Verify that the EXC flag is not set, and the Ready flag is set.
2. Execute a DOAS instruction to select the drive.
3. Execute a DOAS instruction to read the tape status (see read status procedure, Section 3.4.3). Verify that the cartridge is in the tape drive. If the BOT flag is set, go to step 5.
4. Execute a DOAS instruction to rewind the tape to BOT.
5. Set On-line flag to 1. If the data to be read is in the first file, go to step 9.
6. To advance to the next file, execute a DOAS instruction with a Read File Mark command.
7. Execute a DIA instruction to read the controller status. Verify that the EXC flag is set.
8. Execute a DOAS instruction to read the tape status (see read status procedure). Verify that the EXC flag was set by a file mark. If the data to be read is not in the next file, go to step 6.
9. Execute a DOA instruction to issue a Read Data command.
10. Execute a DOB instruction to specify the starting memory address.
11. Execute a DOCS instruction to specify the block count and to start operation.

If the EXC flag is not set, a Read Data command may only be followed by a Read Data or a Read File Mark command.

If the On-line flag is reset at any time during read/read-file-mark operation, the streaming tape drive will complete reading the block in progress, then rewind the tape to BOT. This effectively terminates the read operation.

3.4.3 READ STATUS PROCEDURE

The Read Status command may be used at any time when the Controller Busy flag is set. This command is the only legal command after the EXC flag is set. Proceed as follows:

1. Execute a DIA instruction to read the controller status. Verify that the EXC flag is set, or the Ready flag is set.
2. Execute a DOAS instruction with a Read Status command.
3. Wait for the Done flag. Execute a DIAC instruction. Bits 8-15 are the first status byte from the streaming tape drive. Save the contents of this byte.
4. Execute an NIOP instruction to request the next status byte.
5. Wait for an interrupt, or execute a DIA instruction until bit 4 (Interrupt flag) is set. Bits 8-15 are the next status byte. Save the contents of this byte, and repeat steps 4 and 5 until six status bytes are received.
6. Execute an NIOP instruction to terminate status mode.
7. Wait for Interrupt flag or bit 4 set in the controller status before issuing any new commands.
8. Execute an NIOC instruction to reset the Interrupt flag.

The Read Status command places the streaming tape drive into the read-status mode. In this mode, the streamer sends six bytes of status information. The sequence of commands is defined as follows:

<u>Instruction</u>	<u>Result</u>
DOAS	Reads Status Mode
DIAC	Status Byte #1
NIOP	Interrupt
DIA	Status Byte #2
NIOP	Interrupt
DIA	Status Byte #3
NIOP	Interrupt
DIA	Status Byte #4
NIOP	Interrupt
DIA	Status Byte #5
NIOP	Interrupt
DIA	Status Byte #6
NIOP	Interrupt
NIOC	Ready for new command

The last NIOP notifies the streamer that the sixth status byte has been read. The Interrupt flag is also available as bit 4 of the DIA read-status accumulator. Table 3-1 defines the status bytes.

4.2.15 READ TAPE CONTROLLER STATUS INSTRUCTION

Instruction Mnemonic: **DIA[f] ac,42**

Instruction Function: Loads the LOTUS Streaming Tape Controller's status flags and the data on the bidirectional data bus into the specified accumulator. Figure 4-16 illustrates the accumulator format for the Read Tape Controller Status instruction. Table 4-15 defines accumulator bit functions.

NOTE

Do not use this command while the Controller Busy flag is set.

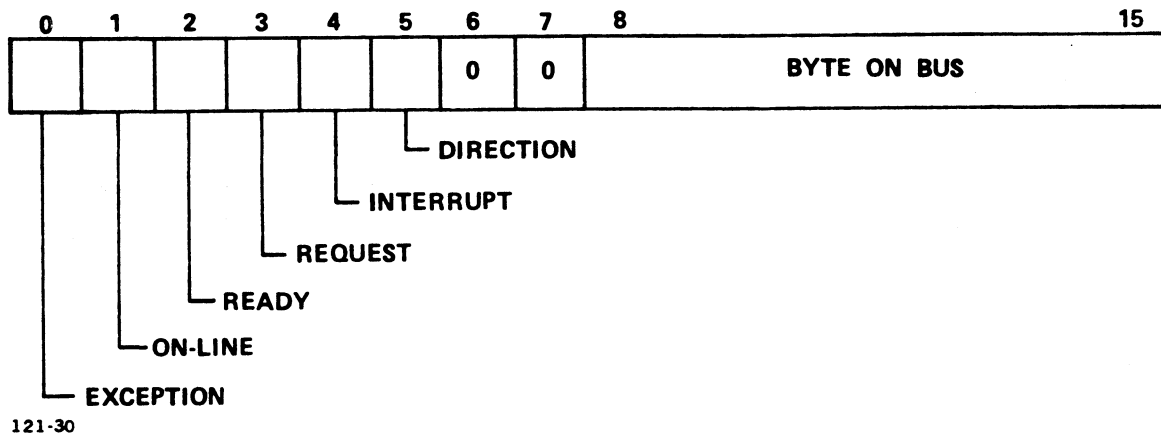


Figure 4-16. Read Tape Controller Status Instruction

TABLE 4-15. READ TAPE CONTROLLER STATUS BIT FUNCTIONS

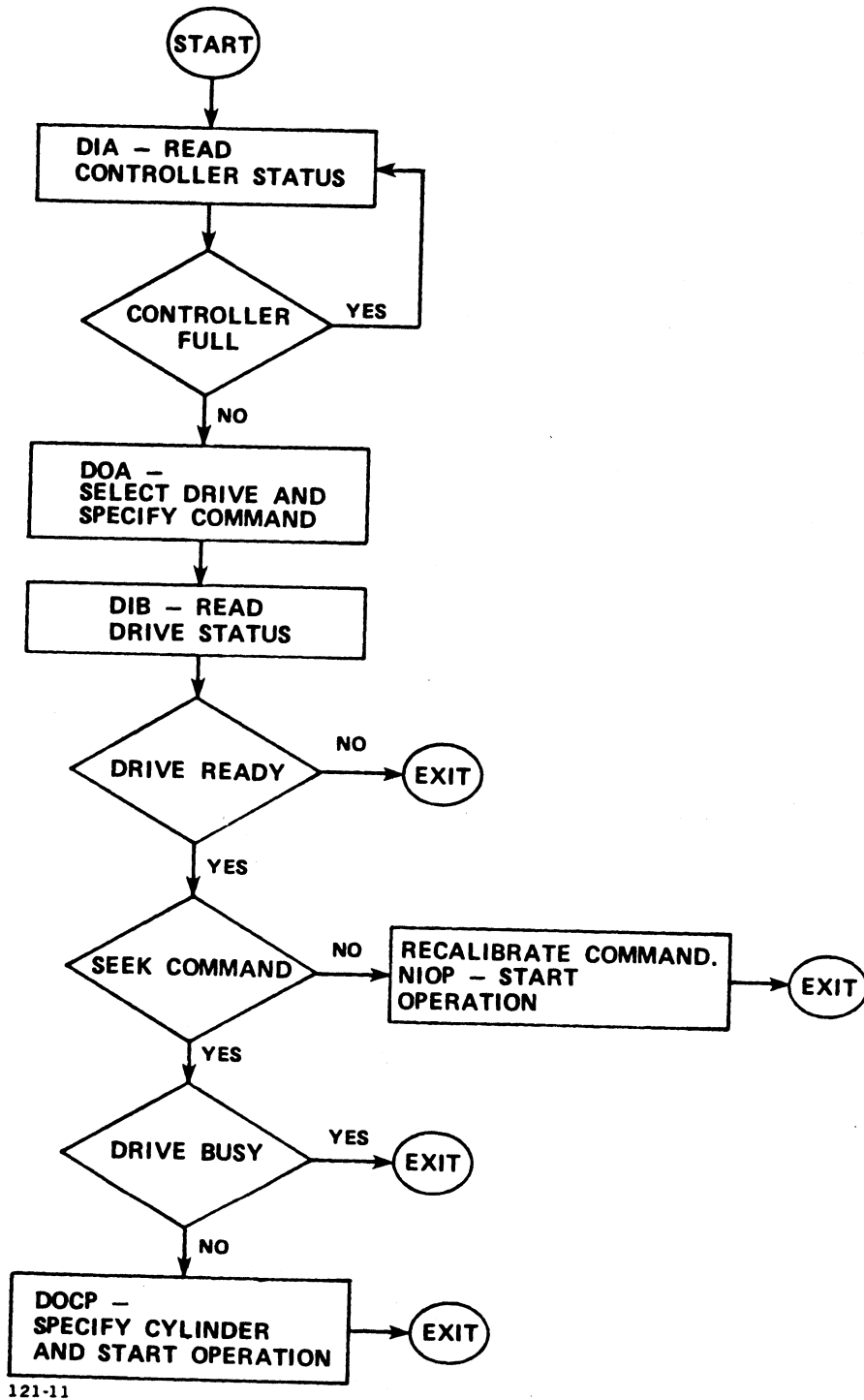
Bits	Function
0	Exception (EXC) - The streaming tape drive detected an error condition, or found a file mark, or received a Reset signal.
1	On-line - Status of Bit 0 of the command register.
2	Ready - Current state of the Ready signal from the streaming tape drive.
3	Request - Current state of the Request signal.
4	Interrupt - Next byte is on the bidirectional data bus in a read status operation.
5	Direction (DIRC) - When set, byte on bidirectional data bus is transmitted by streaming tape drive.
6-7	Unused. Set to zero.
8-15	Byte on Bus - If Busy flag is not set and DIRC is not set, this byte is the content of the controller's command register.

TABLE 3-1. STATUS BYTE DEFINITIONS

Byte	Bit	Operation	Exception Status
0	8	-	Exception byte 0
	9	-	Cartridge not in place
	10	-	Drive not on-line
	11	-	Write protected
	12	-	End of tape
	13	-	Irrecoverable data error
	14	-	Block in error not detected
	15	-	File mark detected
1	8	-	Data exception byte 1
	9	-	Illegal command
	10	-	No data detected
	11	-	Reserved - Set to 0
	12	-	Reserved - Set to 0
	13	-	Reserved - Set to 0
	14	-	Reserved - Set to 0
	15	-	Reset occurred
2&3	-	Write	Data error counter: Number of blocks rewritten
		Read	Data error counter: Number of soft read errors
4&5		Write	Number of buffer underruns
		Read	Number of buffer overruns

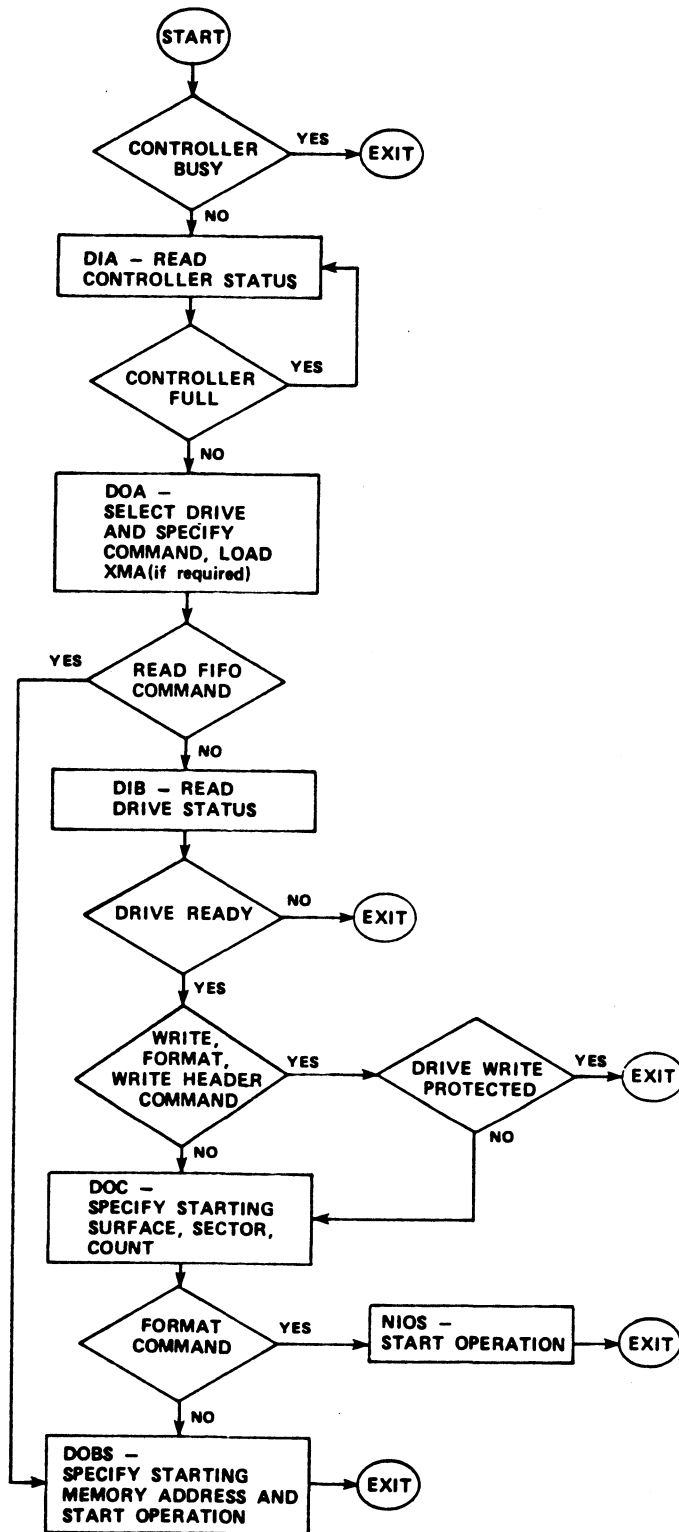
3.5 PROGRAMMING FLOWCHARTS

Figures 3-4 through 3-6 are flowcharts of programming procedures for LOTUS 710 Disk Controllers. Figures 3-7 through 3-9 are flowcharts of programming procedures for LOTUS 720 Streaming Tape Controllers.



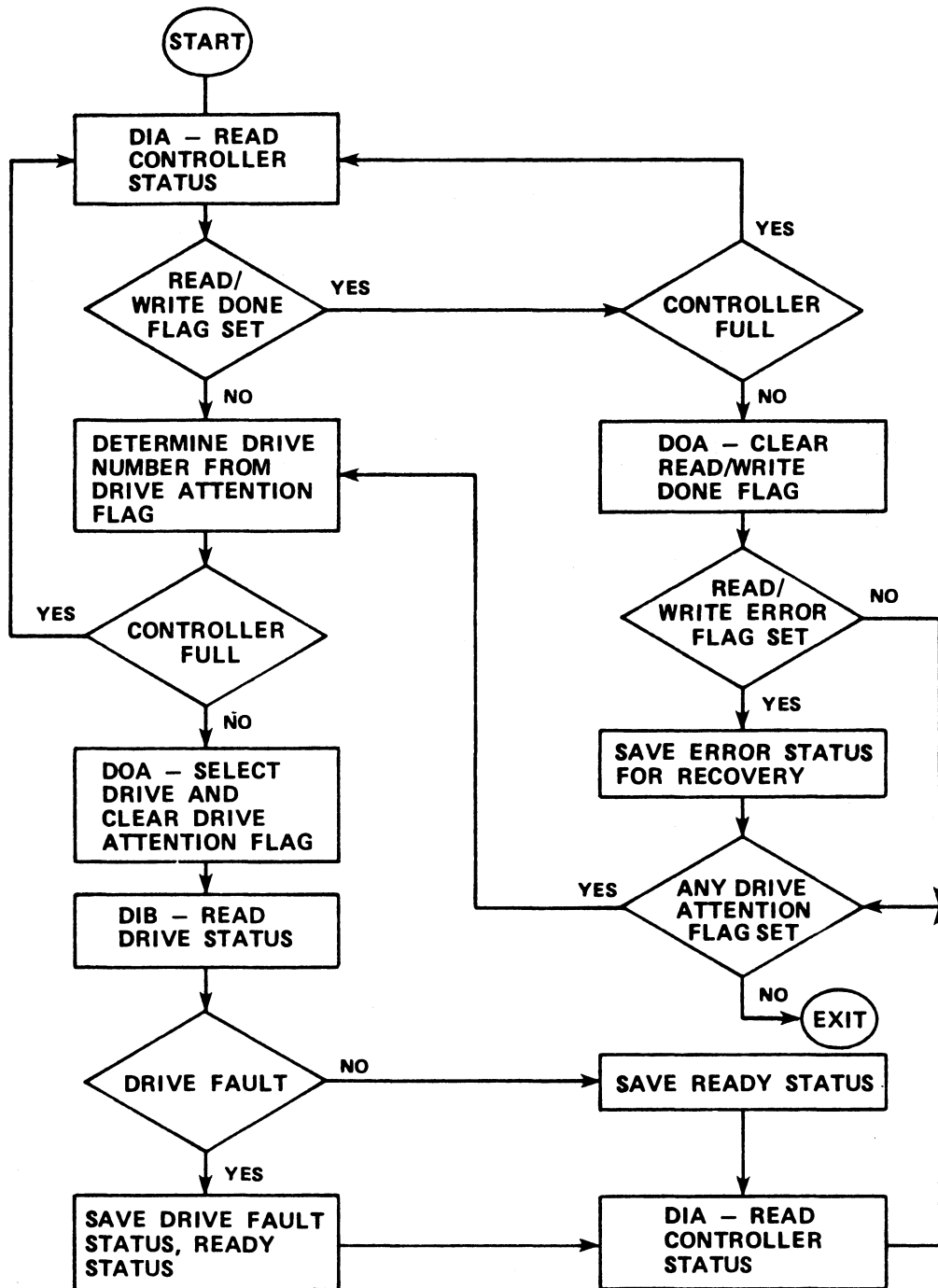
121-11

Figure 3-4. Disk Drive Command Operation



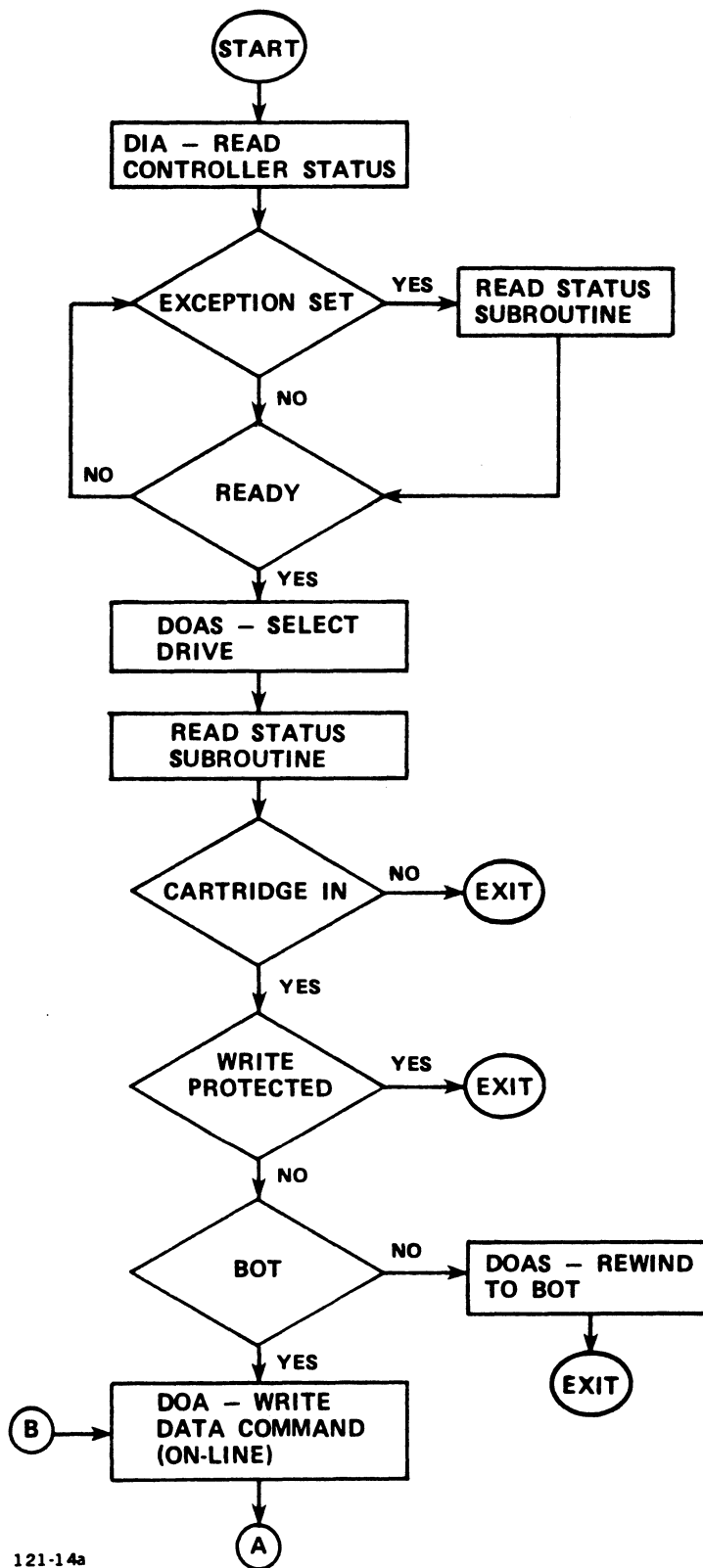
121-12

Figure 3-5. Disk Data Transfer Operation



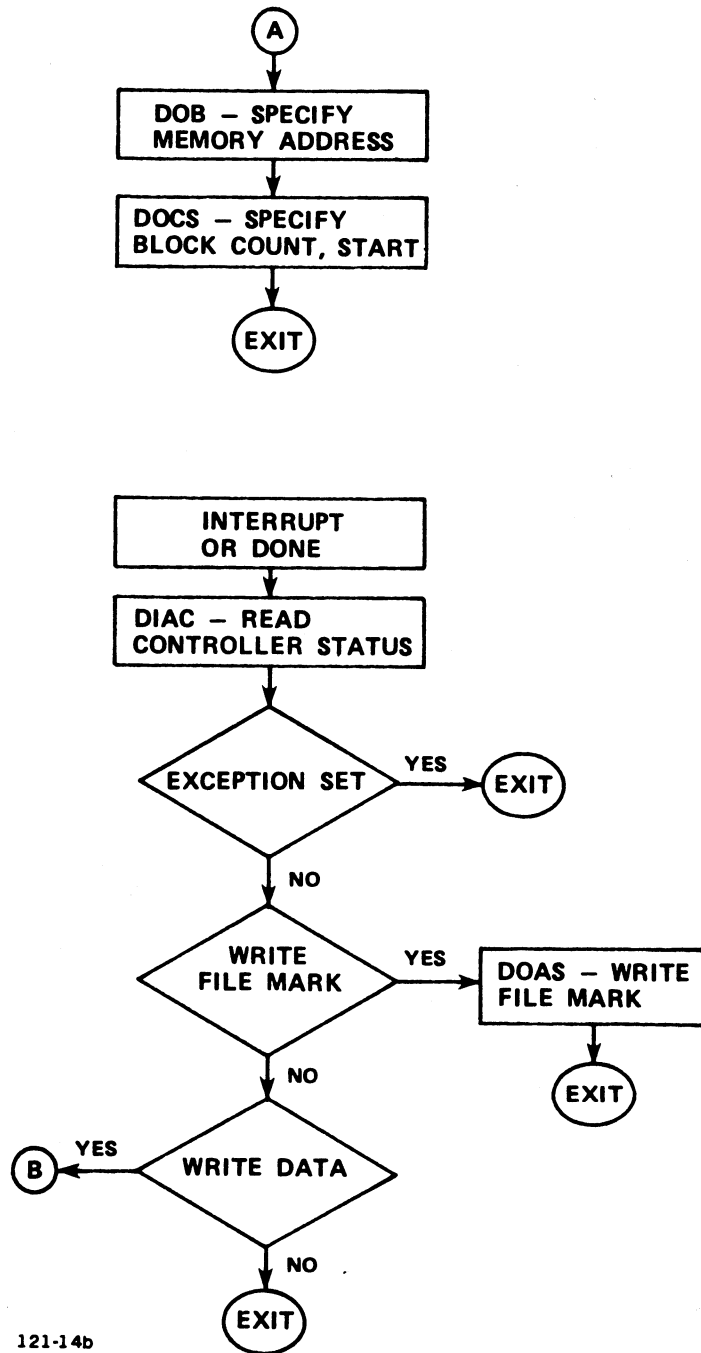
121-13

Figure 3-6. Disk Controller Interrupt Processing



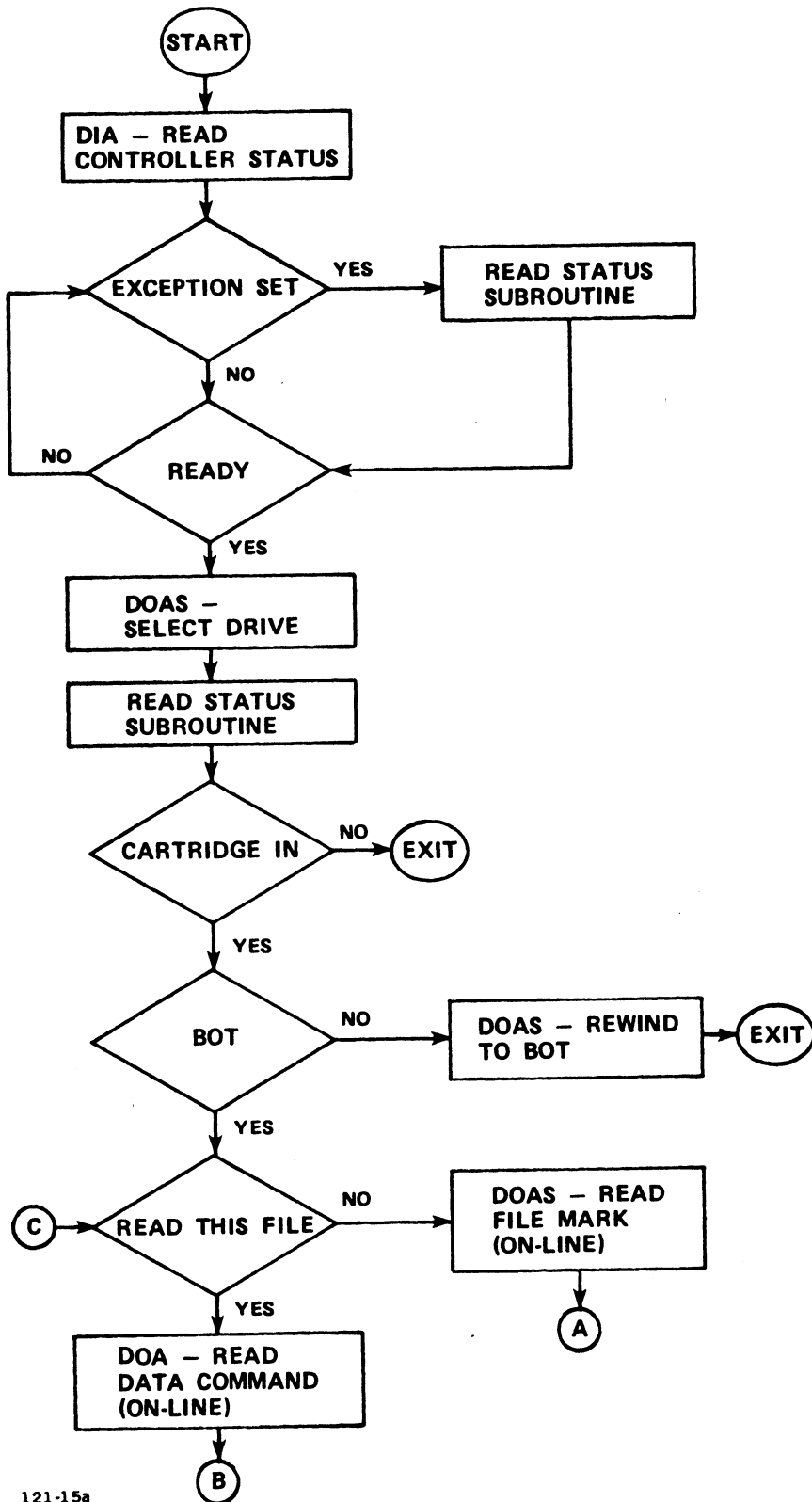
121-14a

Figure 3-7. Tape Controller Write Data (1 of 2)



121-14b

Figure 3-7. Tape Controller Write Data (2 of 2)



121-15a

Figure 3-8. Tape Controller Read Data (1 of 2)

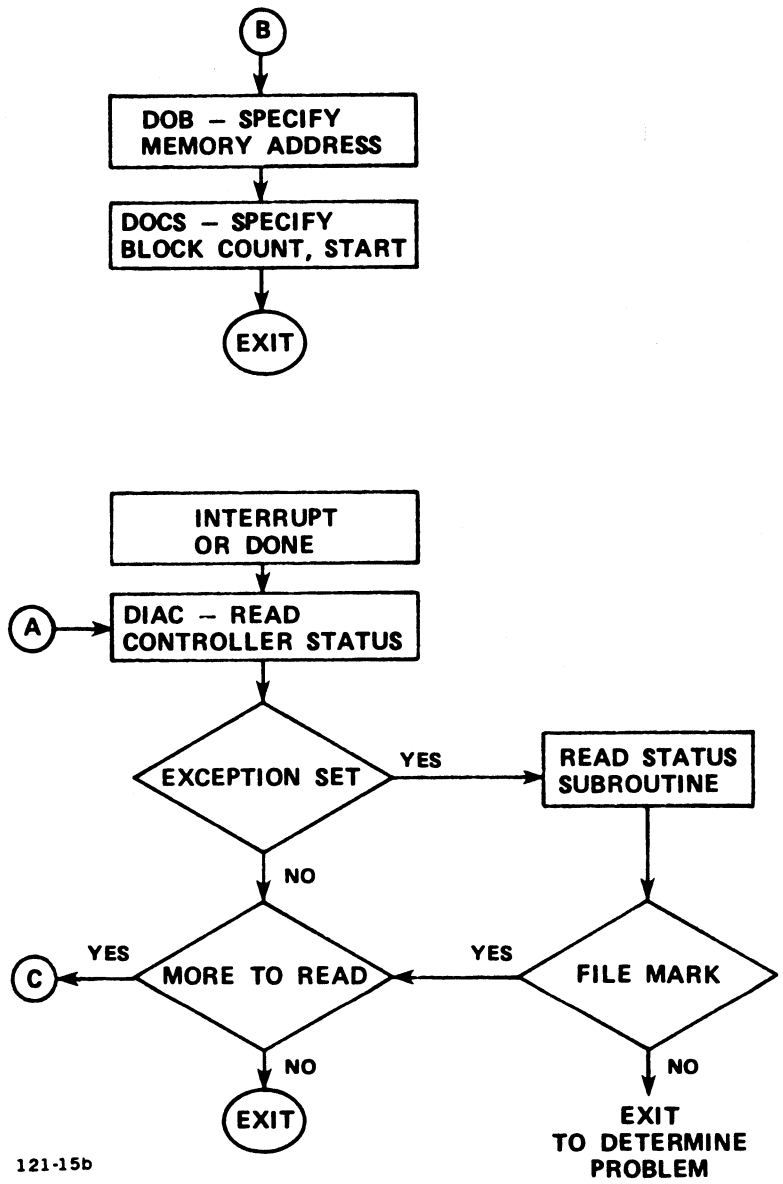
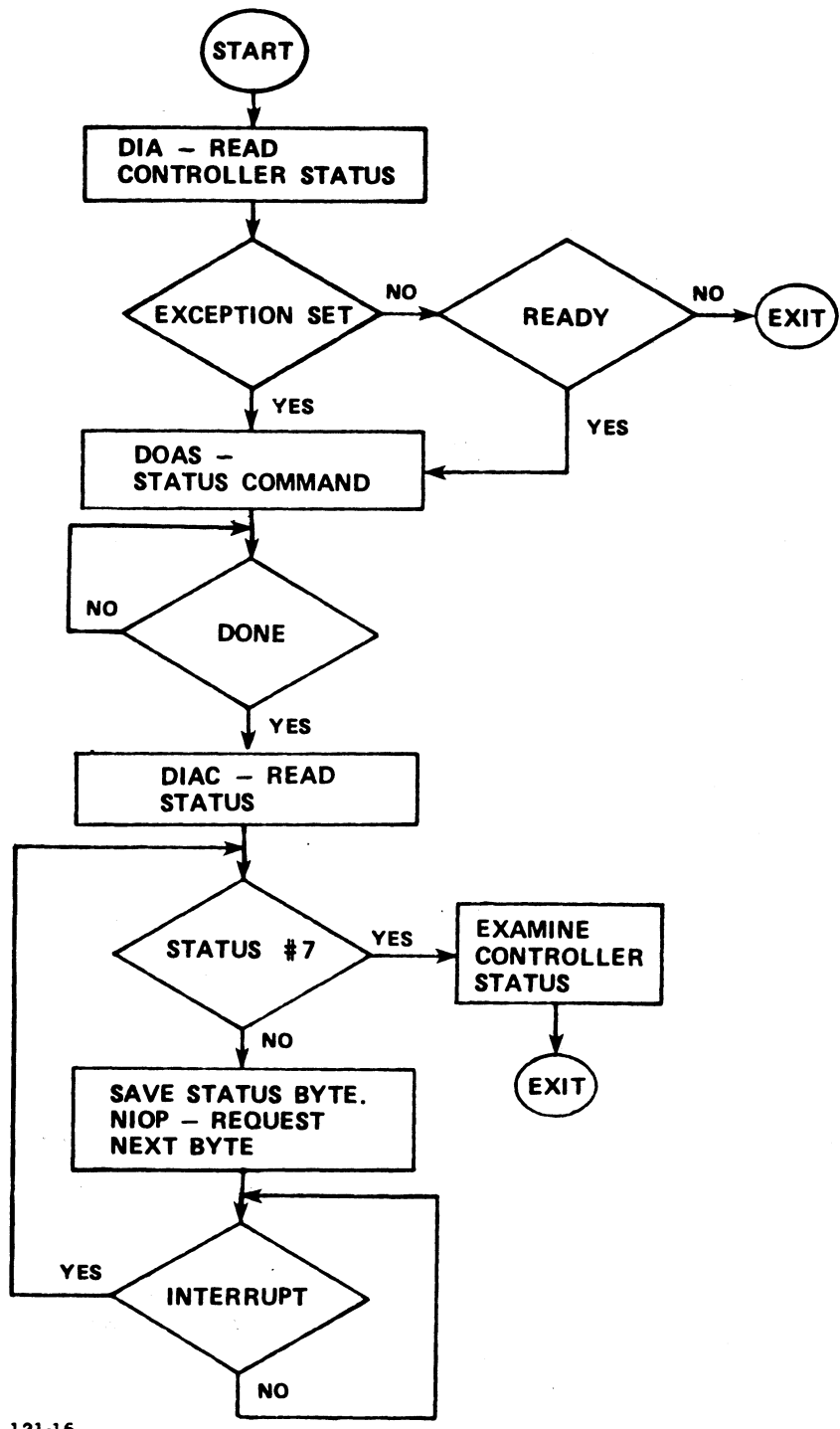


Figure 3-8. Tape Controller Read Data (2 of 2)



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Figure 3-9. Tape Controller Read Status

Section 4

INSTRUCTION SET

4.1 INTRODUCTION

This section describes instructions for the following functions:

- Reading disk or tape controller status
- Reading disk or tape drive status
- Disk or tape controller commands
- Data channel transfers

Sections 4.2.1 through 4.2.11 describe the disk controller instructions.

Sections 4.2.12 through 4.2.17 describe tape controller instructions.

4.2 INSTRUCTIONS

Input/output (I/O) instructions enable the processor to communicate with peripheral devices in the computer system. I/O instructions transfer data between accumulators and devices or device controllers, start or reset device operations, and check the status of each device. These instructions also transfer information on the starting block in computer memory, the block length, the disk cylinder/surface/starting sector address and the function to be performed. Each I/O instruction contains a 6-bit device code field that specifies the particular device for this data transfer.

Figure 4-1 illustrates the I/O instruction word format.

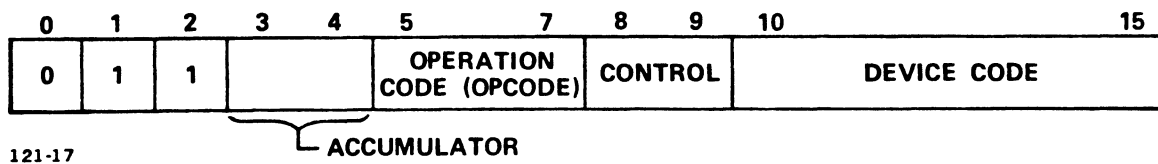


Figure 4-1. I/O Instruction Format

An I/O instruction is designated by 011 in bits 0-2. The Operation Code (OPCODE) and Control (CTRL) fields define the I/O operation to be performed. When a register data transfer is involved, the accumulator field (bits 3-4) specifies the accumulator involved in the data transfer. Bits 10-15 select the device that is to respond to the instruction.

In order to program register data transfers, the programmer must properly code the processor instruction and also load the specified processor accumulator (if required) with the information to be transferred to the LOTUS controllers. Data-out (to the controller) transfers require both the instruction coding and loading of an accumulator with information for the LOTUS controllers. Data-in (to the processor) transfers require only instruction coding since information will be read from the disk or tape controller into the specified accumulator.

Four data-out instructions supply the LOTUS 710 Disk Controller with all information necessary to perform any operation required. To obtain status information from the LOTUS 710 Disk Controller, seven data-in instructions are provided. To obtain status information from the LOTUS 730 Multifunction Controller, six data-in instructions are provided.

4.2.1 SPECIFY COMMAND AND DRIVE INSTRUCTION

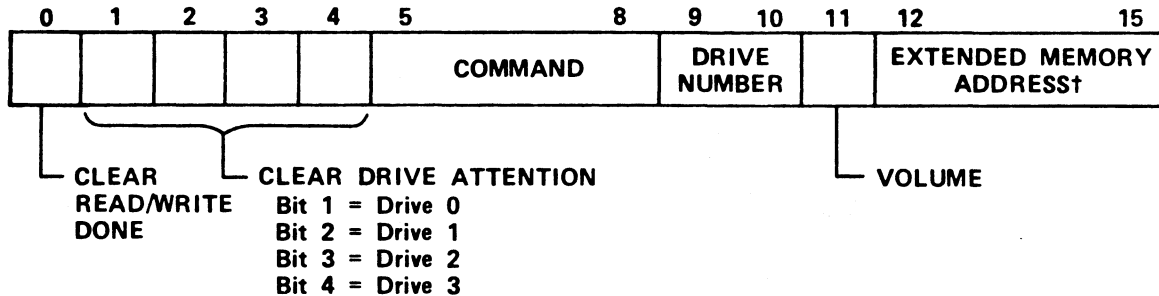
Instruction Mnemonic: **DOA[f] ac,DSKP**

Instruction Function: Clears the Done/Drive Attention flags, as selected by bits 0-4 of the specified accumulator, to zero. Loads bits 5-8 of the accumulator into the controller's command register. Loads bits 9 and 10 of the accumulator into the controller's drive select register. For CMD drives, loads bit 11 into the controller's volume select register. Loads bits 12-15 into the LOTUS 710 auxiliary register. Bits 12-15 are unused by the LOTUS 730.

NOTE

This instruction is ignored if the controller full bit is set to one.

Figure 4-2 illustrates the accumulator format for the specify command and drive instruction. Table 4-1 defines accumulator bit functions.



†Extended Memory Address (XMA) in LOTUS 710 only.
Bits 12-15 in LOTUS 730 are unused and are set to zero.

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Figure 4-2. Specify Command and Drive Instruction

TABLE 4-1. SPECIFY COMMAND AND DRIVE INSTRUCTION BIT FUNCTIONS

Bits	Function
0	Clears Read/Write Done flag.
1-4	Clears the respective Seek Drive Attention flags for drives 0-3.
5-8	<p data-bbox="475 590 607 617">Command</p> <p data-bbox="513 653 1400 940">0000 Read - Reads data up to 32 consecutive sectors from the selected drive starting at the specified surface and sector on the cylinder selected by the previous seek command. Data is read from up to 32 consecutive sectors into computer memory starting at the specified memory address. Surface or cylinder boundaries are crossed if necessary.</p> <p data-bbox="624 978 1400 1482">The controller finds and verifies the header of the desired sector(s). The controller reads the data and transmits it via the DMA channel to computer memory. During sector read the controller accumulates an ECC checkword. This checkword is compared with the ECC checkword generated when the data was written to disk. The controller rereads and retransmits the same sector if an ECC error occurs. If an ECC error occurs again, the controller terminates the operation. Installation of the automatic retry jumper (location 9C) is necessary for retry on occurrence of an ECC error.</p> <p data-bbox="513 1520 1400 1646">0001 Recalibrate - Moves the heads of the selected disk drive to cylinder zero (0) and attempts to clear drive faults (if any).</p> <p data-bbox="513 1684 1400 1810">0010 Seek - Moves the heads of the selected disk drive to the specified cylinder. In cartridge module drives, switches to the desired volume.</p>

TABLE 4-1. SPECIFY COMMAND AND DRIVE INSTRUCTION BIT FUNCTIONS (Cont)

Bits	Function
5-8	<p>Command (Cont)</p> <p>0011 Write Header - Writes three header words, transferred from a specified computer memory address, into a maximum of 32 consecutive sectors in the selected drive. The header is written from memory (starting at the specified memory address) onto the disk (starting at the specified surface and sector) on the cylinder selected by the previous seek command. Surface or cylinder boundaries are crossed if necessary.</p> <p>The controller finds the specified sector and writes the preamble, sync bit, header, header CRC, and gap into the sector using the three words from memory. The data portion of each sector remains intact.</p>
	<p>0100 Read Offset (+) - Same as a Read command except with the disk drive heads offset towards the spindle. This command is used for data recovery. Offset is only for the duration of this command.</p>
	<p>0101 Read Offset (-) - Same as a Read command except with the disk drive heads offset away from the spindle. This command is used for data recovery. Offset is only for the duration of this command.</p>
	<p>0110 Format - Formats up to 32 consecutive sectors in the selected disk drive starting at the specified surface and sector on the cylinder selected by the previous seek command. Surface or cylinder boundaries are crossed if necessary.</p> <p>The controller finds the specified sector and writes the preamble, sync bit, header, header CRC, gap, data splice, preamble, sync bit, all zero data, ECC and postamble into the sector using address information from the controller. Any data previously written in this sector is lost.</p>

TABLE 4-1. SPECIFY COMMAND AND DRIVE INSTRUCTION BIT FUNCTIONS (Cont)

Bits	Function
5-8	Command (Cont)
	0111 Reserved. Do not use.
	1000 Reserved. Do not use.
	1001 Alternate Mode 1 - In Alternate Mode 1, the DIA instruction reads the controller's memory address register and the DIB instruction reads the controller's extended memory address register. All other commands in this instruction turn off Alternate Modes 1 and 2.
	1010 Alternate Mode 2 - In Alternate Mode 2, the DIA and DIB instructions read the ECC remainder words. All other commands in this instruction turn off Alternate Modes 1 and 2.
1011 No operation.	
1100 Data Verify - Reads up to 32 consecutive sectors from the selected drive, starting at the specified surface and sector on the cylinder selected by the previous seek command. Data read from the disk drive is compared word-by-word to data read from computer memory starting at the specified memory address. Surface or cylinder boundaries are crossed if necessary. The controller finds and verifies the header of the specified sector(s); reads the data and compares it to data read from computer memory. During sector read the controller accumulates an ECC checkword. This ECC checkword is compared with the recorded checkword. If an ECC or data compare error is detected, the operation terminates without retry.	

TABLE 4-1. SPECIFY COMMAND AND DRIVE INSTRUCTION BIT FUNCTIONS (Cont)

Bits	Function
5-8	<p>Command (Cont)</p> <p>1101 Read FIFO - This is a diagnostic test command. Eighteen words of data will be read into memory starting at the specified memory address. The FIFO buffer must first be filled by issuing a verify command to a write-enabled drive. After a 20 to 30-microsecond wait, an NIOC must be issued to the controller. The Read FIFO command is then issued.</p>
	<p>1110 Write - Writes up to 32 consecutive sectors from memory starting at the specified memory address onto the selected drive. Writing starts at the specified surface and sector on the cylinder specified in the previous seek command. Surface or cylinder boundaries are crossed if necessary.</p> <p>The controller finds and verifies the header of the specified sector and writes 256 words of data from memory onto the specified sector. During write the controller accumulates a 32-bit ECC and appends it to the data field.</p>
	<p>1111 Read Format - The controller finds the desired sector and reads the three-word sector header, header CRC and two-word ECC from up to 32 consecutive sectors on the selected drive, starting at the specified surface and sector on the cylinder selected by the previous seek command. The data read is transferred into computer memory starting at the specified memory address. Surface or cylinder boundaries are crossed if necessary.</p>
9-10	<p>Selects drive. Also selects drive status register.</p>
11	<p>Volume select bit. Defines nonremovable surface(s) in CMD drives.</p>

TABLE 4-1. SPECIFY COMMAND AND DRIVE INSTRUCTION BIT FUNCTIONS (Cont)

Bits	Function
12-15	<p>LOTUS 710: Extended memory address. Used by non-POINT 4 Map.</p> <p>LOTUS 730: Unused. Set to zero.</p>

4.2.2 SPECIFY MEMORY ADDRESS INSTRUCTION

Instruction Mnemonic: **DOB[f] ac,DSKP**

Instruction Function: Loads bits 0-15 of the specified accumulator into the controller's memory address register. Transfers the four extended memory address (XMA) bits from the auxiliary register of the controller into the XMA address register. POINT 4 minicomputers do not use the XMA bits, the auxiliary register, or XMA register. Non-POINT 4 mapped memory minicomputers may require use of the XMA bits, the auxiliary register and XMA register. The auxiliary and XMA registers apply to the LOTUS 710 only. The LOTUS 730 does not contain these items or use the XMA bits.

NOTE

This instruction is ignored if the Busy flag is set to one.

Figure 4-3 illustrates the accumulator format for the Specify Memory Address instruction. Table 4-2 defines accumulator bit function.

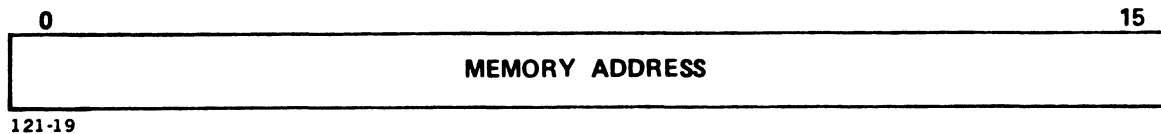


Figure 4-3. Specify Memory Address Instruction

TABLE 4-2. SPECIFY MEMORY ADDRESS INSTRUCTION BIT FUNCTION

Bits	Function
0-15	Memory address of next data channel transfer.

4.2.3 SPECIFY CYLINDER INSTRUCTION

Instruction Mnemonic: **DOC[f] ac,DSKP**

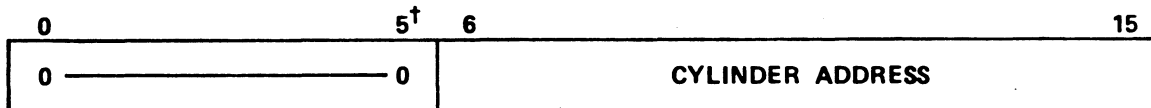
(If the previous DOA specified a Seek command)

Instruction Function: Loads bits 6-15 into the cylinder bits of the controller's cylinder register.

NOTE

This instruction is ignored if the controller full bit is set to one.

Figure 4-4 illustrates the accumulator format for the Specify Cylinder instruction. Table 4-3 defines accumulator bit functions.



†Bit 5 is MSB for LOTUS 730 only.

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Figure 4-4. Specify Cylinder Instruction

TABLE 4-3. SPECIFY CYLINDER BIT FUNCTIONS

Bits	Functions
0-5	Unused. Set to zero.
6-15	Cylinder address for seek operation.

NOTE

The accumulator format of the LOTUS 710 Disk Controller and the LOTUS 730 Multifunction Controller differ slightly for this instruction. The LOTUS 730 Multifunction Controller uses bits 5 through 15. The MSB of the cylinder address is bit 5.

4.2.4 SPECIFY SURFACE, SECTOR AND SECTOR COUNT INSTRUCTION

Instruction Mnemonic: **DOC[f] ac,DSKP**

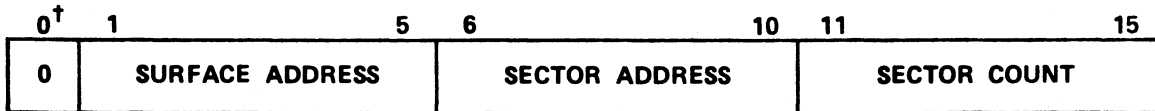
(If the previous DOA specified other than a Seek command)

Instruction Function: Loads bits 1-5 of the specified accumulator into the LOTUS 710 Disk Controller's surface address register. Loads bits 0-5 of the specified accumulator into the LOTUS 730 Multifunction Controller's surface address register. Loads bits 6-10 of the specified accumulator into the controller's sector address register. Load bits 11-15 of the specified accumulator into the controller's sector count register.

NOTE

This instruction is ignored if the Busy flag is set to one.

Figure 4-5 illustrates the accumulator format for the Specify Surface, Sector and Sector Count instruction. Table 4-4 defines accumulator bit functions.



†Bit 0 is MSB of surface address for LOTUS 730 only.

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Figure 4-5. Specify Surface, Sector and Sector Count Instruction

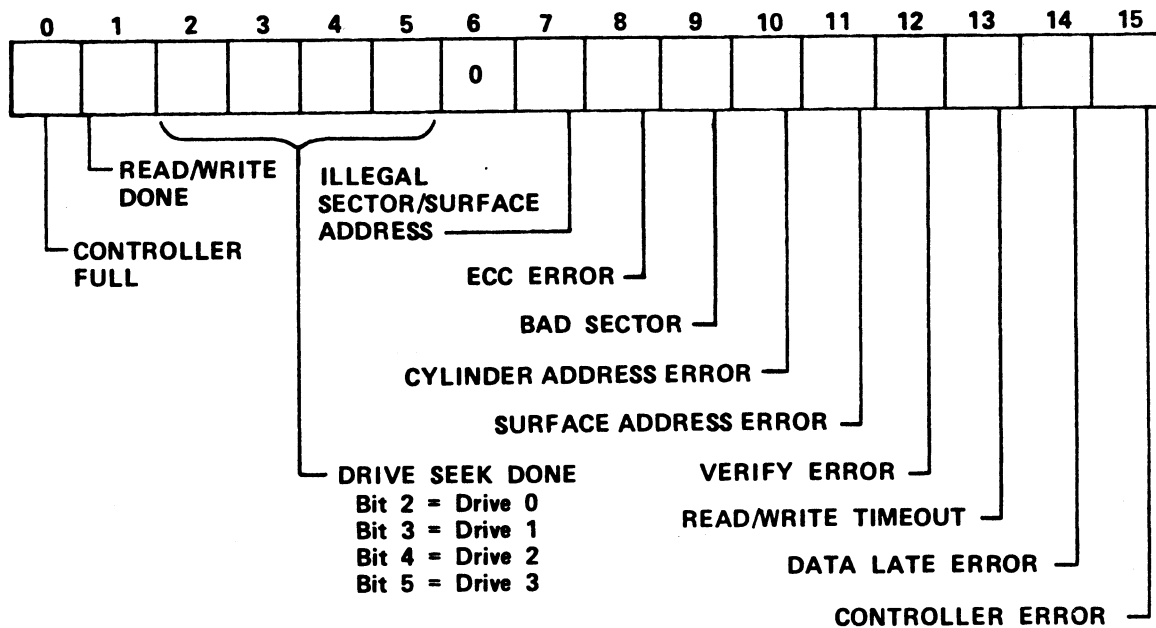
TABLE 4-4. SPECIFY SURFACE, SECTOR AND SECTOR COUNT BIT FUNCTIONS

Bits	Functions
0	LOTUS 710: Unused. Set to zero. <p style="text-align: center;">NOTE</p> The LOTUS 730 Multifunction Controller uses bits 0-5 for the starting surface address. Bit 0 is the MSB.
1-5	Starting surface address for data transfer operation.
6-10	Starting sector address for data transfer operation.
11-15	Two's complement of the number of sectors to be transferred in one operation.

4.2.5 READ CONTROLLER STATUS INSTRUCTION

Instruction Mnemonic: **DIA[f] ac,DSKP**

Instruction Function: Loads the controller's status flags into bits 0-15 of the specified accumulator. Figure 4-6 illustrates the accumulator format for the Read Controller Status instruction. Table 4-5 defines accumulator bit functions.



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Figure 4-6. Read Controller Status Instruction

Three data-out instructions supply the LOTUS 720 Streaming Tape Controller with all the necessary information for any operation. Three data-in instructions allow the operating program to determine the streaming tape drive status.

In the description that follows, coding conventions are used so that the assembler can recognize and translate the instruction into machine language. Instructions are coded according to the following format.

MNEMONIC [optional mnemonics] **OPERAND STRING**

The mnemonic shown in bold print must be coded exactly as shown in the instruction description. For example, the mnemonic for the Data Out to Buffer A instruction is:

DOA

Operands printed in bold print are also required to be coded exactly as shown.

Some instructions have optional mnemonics that are appended to the main mnemonic if the option is desired. These mnemonics are enclosed in []. Optional mnemonics may require substitution of a specific control character in order to be properly decoded. Instructions for controlling data transfer between the processor and the disk (or tape) controller use two optional fields:

ac = accumulator

f = control function

The accumulator field (ac) designates one of four accumulators (0, 1, 2, or 3). The accumulator sends information to the controller or receives information from the controller.

The control function field (f) controls the LOTUS 710 Disk Controller's Busy and Done flags as follows:

f = S
(Start) Sets the Busy flag to one; clears the Done flag to zero; clears all controller error flags; starts R/W timeout. Disables drive attention interrupts; starts the following operations as specified in the command: read, read offset, format, write header, verify, read buffer, write, read header.

f = C
(Clear) Clears the Busy flag to zero; clears Done flag to zero; terminates any data transfer operation; clears all controller error flags; clears all drive attention flags. It does not terminate seek or recalibrate commands.

f = P
(Pulse) Sets the Controller Full flag to one and starts the following operations as specified in the command: recalibrate and seek.

The control function field controls the LOTUS 720 Streaming Tape Controller's Busy, Done and Interrupt flags as follows:

- f = S Sets the Busy flag, clears the Done flag. Initiates request for command transfer to streaming tape drive.
- f = C Clears the Busy, Done and Interrupt flags; stops data transfer.
- f = P In read-drive-status operation: clears the Interrupt flag and requests next byte from streaming tape drive.

A special instruction, IORST, is used to initialize and clear all flags in all I/O devices. This instruction performs the following functions in the disk controller:

- Performs all operations listed above at f = C
- Initiates a recalibrate operation on the lowest numbered ready/nonreserved drive
- Sets the surface/sector address register to zero
- Sets the command register to zero
- Sets the memory address register to zero
- Turns off Alternate Modes 1 and 2

IORST performs the following functions in the streaming tape controller:

- Performs all operations listed at f = C
- Resets controller memory address register
- Resets block count register
- Starts bootstrap sequence

TABLE 4-5. READ CONTROLLER STATUS BIT FUNCTIONS

Bits	Function
0	Controller Full - Drive command initiated by previous IOPLS has not yet been issued to the selected drive.
1	Read/Write Done - Done flag of controller. LOTUS 730 users: reference Table 2-6.
2-5	Drive Seek Done - Seek Done flags of drives. Respective drives have executed a Recalibrate or Seek command, become ready, or rejected an Illegal Seek command.
6	Unused. Set to zero.
7	Illegal Sector/Surface Address - The sector or surface address received by the controller for a data transfer operation exceeds the drive capacity set in the controller. Illegal sector/surface address is detected before any data transfer takes place. The operation terminates with the Error flag (bit 15) and Device Done flag set.
8	ECC Error - An ECC error has been detected during read or verify operations. An ECC error will cause one retry (read only). If the ECC error persists, operation terminates at the end of the sector with Error flag and Device Done flag set. The surface/sector address/sector count points to the next sector to be read. Retry requires installation of the automatic retry jumper (LOTUS 710 only). Reference Table 2-3 for additional information.
9	Bad Sector - The Bad Sector flag is set in the header of the faulty sector. This sector cannot store data reliably. The data transfer is terminated promptly. The surface/sector address/sector count points to the sector in which the error occurred.

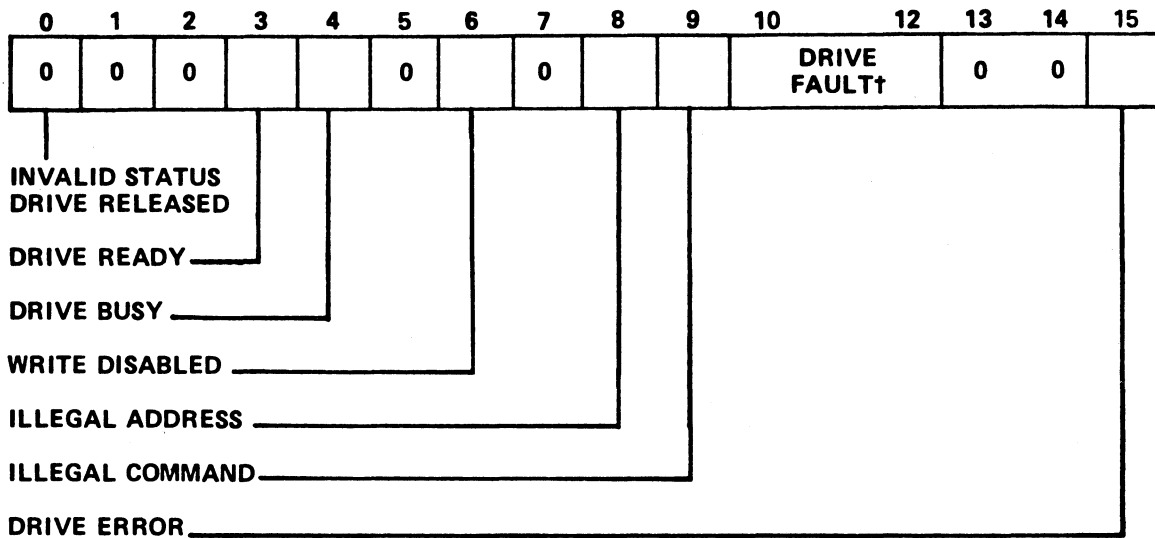
TABLE 4-5. READ CONTROLLER STATUS BIT FUNCTIONS (Cont)

Bits	Function
10	Cylinder Address Error - The heads are not positioned on the cylinder specified by the previous seek operation. Data transfer operations are terminated promptly. The surface/sector address/sector count points to the sector in which the error occurred. A Recalibrate command should be issued to the drive.
11	Surface Address Error - The surface address in the sector header is different from the surface address currently specified. The data transfer operation is terminated promptly. The surface/sector address/sector count points to the sector in which the error occurred.
12	Verify Error - The data read from the disk did not match data read from computer memory. The data transfer operation is terminated at the end of the sector with Error flag and Device Done flag set to one. The surface/sector address/sector count points to the next sector to be verified.
13	Read/Write Timeout - The data transfer operation initiated by the last f = S (start) was not completed in 1 second. The data transfer operation is terminated promptly. The surface/sector address/sector count points to the sector in which the error occurred.
14	Data Late Error - The FIFO buffer overflowed or underflowed. The data channel did not support the transfer rate required by the controller. Data transfer operation is terminated promptly. The surface/sector address/sector count points to the sector in which the error occurred.
15	Controller Error Flag - One or more error flags listed above or a Drive Error flag (see Section 4.2.6.1) on the selected drive has been set to one.

4.2.6 READ DRIVE STATUS INSTRUCTION

Instruction Mnemonic: **DIB[f] ac,DSKP**

Instruction Function: Loads the drive status flags of the drive selected by the previous DOA instruction into bits 0-15 of the specified accumulator. Figure 4-7 illustrates the format for the Read Drive Status instruction. Table 4-6 defines accumulator bit functions.



†Bits 10-12 = Drive Fault in LOTUS 710 only.
 In the LOTUS 730:
 Bits 10-11 = Unused. Set to zero
 Bit 12 = Drive Fault

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Figure 4-7. Read Drive Status Instruction

TABLE 4-6. READ DRIVE STATUS INSTRUCTION BIT FUNCTIONS

Bits	Function
0	Invalid. Drive is released.
1	Drive Reserved. Drive reserved by another controller.
2	Unused. Set to zero.
3	Drive Ready.
4	Drive Busy - Drive is executing a position command.
5	Unused. Set to zero.
6	Write Disabled.
7	Unused. Set to zero.
8	Illegal Address - The cylinder address received by the drive exceeds the capacity of the drive or a Seek command was not completed in 500 milliseconds by the drive. An automatic recalibrate is issued by the controller.
9	Illegal Command - A Seek command was issued to a busy drive or a Write command was issued to a write-protected drive.
10-12 (LOTUS 710)	Drive Fault - Any drive fault. A drive fault on the selected drive during data transfer terminates operation, sets to one the Device Done flag and the Controller Error flag. If the controller detects a drive fault, it issues a Fault Clear command to that drive. If the controller detects a Seek error in the drive it issues a Recalibrate command to that drive. It also sets to one the Drive Done flag.

TABLE 4-6. READ DRIVE STATUS INSTRUCTION BIT FUNCTIONS (Cont)

Bits	Function
10-11 (LOTUS 730)	Unused. Set to zero.
12 (LOTUS 730)	Drive Fault. Same as LOTUS 710.
13-14	Unused. Set to zero.
15	Drive Error Flag - One or more of the error conditions listed above exist.

4.2.7 READ MEMORY ADDRESS INSTRUCTION (ALTERNATE MODE 1)

Instruction Mnemonic: **DIA[f] ac,DSKP**
(in Alternate Mode 1)

Instruction Function: Loads the contents of the controller's memory address register into bits 0-15 of the specified accumulator. On ECC error, this instruction returns the memory address of the sector following the sector with the ECC error. Other errors (e.g., data late) return an indeterminate value. Figure 4-8 illustrates the format for the Read Memory Address instruction. Table 4-7 defines the accumulator bit function.

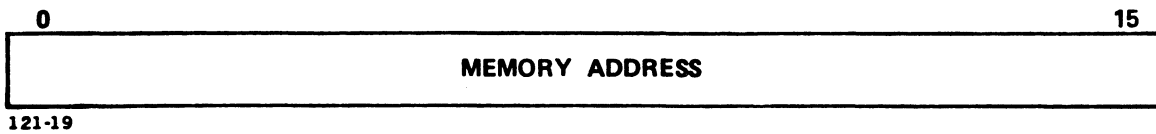


Figure 4-8. Read Memory Address Instruction (Alternate Mode 1)

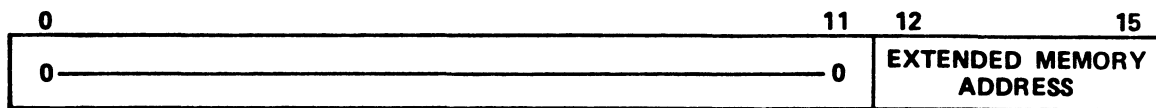
TABLE 4-7. READ MEMORY ADDRESS BIT FUNCTION (ALTERNATE MODE 1)

Bits	Function
0-15	Memory address of next data channel transfer.

**4.2.8 READ EXTENDED MEMORY ADDRESS INSTRUCTION
(ALTERNATE MODE 1)**

Instruction Mnemonic: **DIB[f] ac,DSKP**
(in Alternate Mode 1)

Instruction Function: Loads the contents of the controller's extended memory address register into bits 12-15 of the specified accumulator. POINT 4 mapped memory minicomputers do not use this instruction. Non-POINT 4 minicomputers may require this instruction. This instruction applies to the LOTUS 710 Disk Controller only. Figure 4-9 illustrates the accumulator format for the Read Extended Memory Address instruction. Table 4-8 defines the accumulator bit functions.



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**Figure 4-9. Read Extended Memory Address Instruction
(Alternate Mode 1)**

**TABLE 4-8. READ EXTENDED MEMORY ADDRESS BIT FUNCTIONS
(ALTERNATE MODE 1)**

Bits	Function
0-11	Unused. Set to zero.
12-15	Extended Memory Address (optional).
NOTE	
This instruction is not part of the LOTUS 730 Multifunction Controller instruction set.	

4.2.9 READ HIGH-ORDER ECCR BITS INSTRUCTION (ALTERNATE MODE 2)

Instruction Mnemonic: **DIA[f] ac,DSKP**
(in Alternate Mode 2)

Instruction Function: Loads the high-order bits of the controller's ECC remainder register into bits 0-15 of the specified accumulator. Figure 4-10 illustrates the accumulator format for the Read High-order ECCR Bits (R0-R15) instruction. Table 4-9 defines accumulator bit functions.

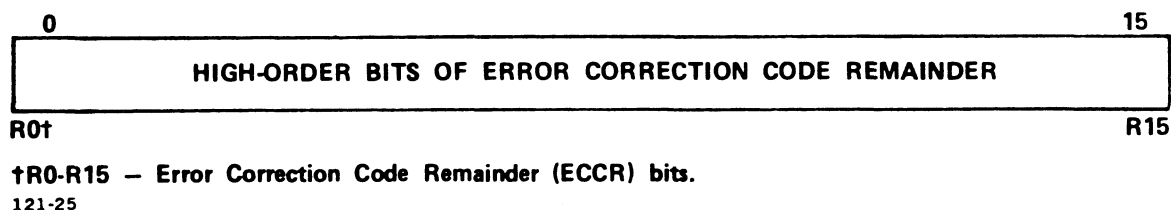


Figure 4-10. Read High-Order ECCR Bits Instruction (Alternate Mode 2)

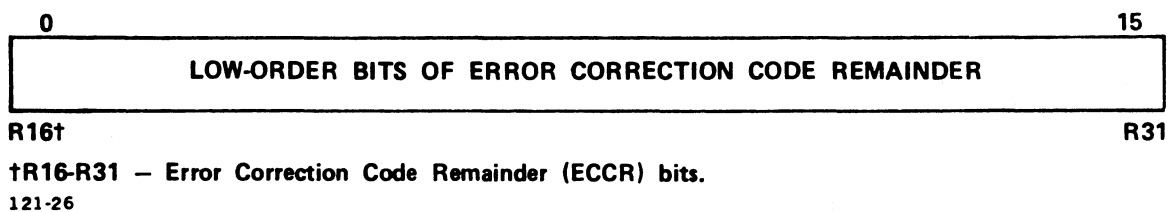
TABLE 4-9. READ HIGH-ORDER ECCR BITS FUNCTION (ALTERNATE MODE 2)

Bits	Function
0-15	High-order bits of ECC remainder following a read or verify operation.

4.2.10 READ LOW-ORDER ECCR BITS INSTRUCTION (ALTERNATE MODE 2)

Instruction Mnemonic: **DIB[f] ac,DSKP**
(in Alternate Mode 2)

Instruction Function: Loads the low-order bits of the controller's ECC remainder register into bits 0-15 of the specified accumulator. Figure 4-11 illustrates the accumulator format for the Read Low-order ECCR Bits (R16-R31) instruction. Table 4-10 defines the accumulator bit function.



**Figure 4-11. Read Low-Order ECCR Bits Instruction
(Alternate Mode 2)**

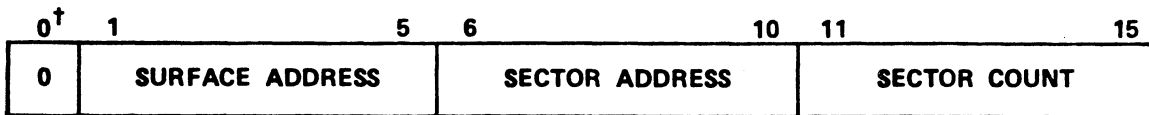
**TABLE 4-10. READ LOW-ORDER ECCR BITS FUNCTION
(ALTERNATE MODE 2)**

Bits	Function
0-15	Low-order bits of ECC remainder following a read or verify operation.

4.2.11 READ SURFACE, SECTOR, SECTOR COUNT INSTRUCTION

Instruction Mnemonic: **DIC[f] ac,DSKP**

Instruction Function: Loads the contents of the LOTUS 710 Disk Controller's surface address register into bits 1-5 of the specified accumulator. Loads the contents of the LOTUS 730 Multifunction Controller's surface address register into bits 0-5 of the specified accumulator. Loads the contents of the controller's sector-address register into bits 6-10 of the specified accumulator. Loads the contents of the controller's sector-count register into bits 11-15 of the specified accumulator. Figure 4-12 illustrates the accumulator format for the Read Surface, Sector, Sector Count instruction. Table 4-11 defines accumulator bit functions.



†Bit 0 is MSB of surface address for LOTUS 730 only.

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Figure 4-12. Read Surface, Sector, Sector Count Instruction

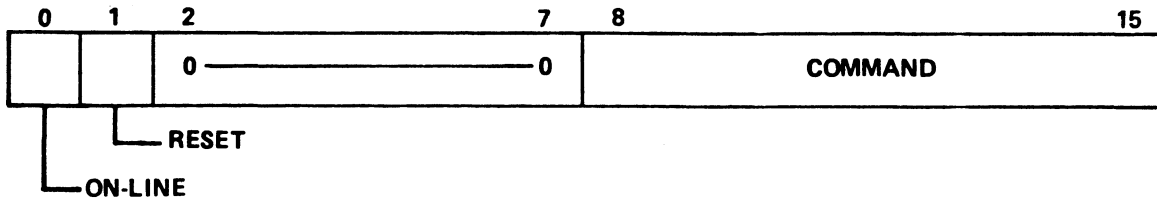
TABLE 4-11. READ SURFACE, SECTOR, SECTOR COUNT BIT FUNCTIONS

Bits	Function
0	Unused. Set to zero.
1-5	Surface address of the sector addressed by bits 6-10. NOTE The accumulator format of the LOTUS 710 Disk Controller and the LOTUS 730 Multifunction Controller differ slightly for this instruction. The LOTUS 730 Multifunction Controller uses bits 0 through 15. The MSB of the surface address is bit 0.
6-10	Sector address of the sector following the last sector that was transferred.
11-15	Two's complement of the number of sectors remaining to be transferred.

4.2.12 SPECIFY COMMAND

Instruction Mnemonic: **DOA[f] ac,42**

Instruction Function: Loads the contents of the specified accumulator into the LOTUS Streaming Tape Controller's command register in the I/O bus interface logic. Bits 0 and 1 of the command register are connected to the streaming tape drive through dedicated lines. Figure 4-13 illustrates the accumulator format for the streaming tape controller Specify Command instruction. Table 4-12 defines accumulator bit functions.



121-27

Figure 4-13. Specify Command Instruction

TABLE 4-12. SPECIFY COMMAND BIT FUNCTIONS

Bits	Function
0	On-line - Must be set to one for read, read-file mark, write and write-file-mark operations.
1	Reset - Issues master reset to the streaming tape drive. Must be set for 13 microseconds minimum.
2-7	Unused.
8-15	<p>Command</p> <p>00000001 Select drive 0</p> <p>00000010 Select drive 1</p> <p>00000100 Select drive 2</p> <p>00001000 Select drive 3</p> <p>00010000 Reserved</p> <p>00100001 Rewind to BOT</p> <p>00100010 Erase tape</p> <p>00100100 Retension tape</p> <p>00100110 Select archive mode</p> <p>00101000 Reserved</p> <p>00110000 Reserved</p> <p>01001001 Select read-cipher-quarterback mode</p> <p>01000000 Write data</p> <p>01100000 Write file mark</p> <p>10000000 Read data</p> <p>10100000 Read file mark</p> <p>11000000 Read status</p> <p>111xxxxx Reserved</p> <p>All other commands are illegal.</p>

4.2.13 SPECIFY MEMORY ADDRESS INSTRUCTION

Instruction Mnemonic: **DOB[f] ac,42**

Instruction Function: Loads the contents of the specified accumulator into the controller's memory address register. Figure 4-14 illustrates the accumulator format for the Specify Memory Address instruction. Table 4-13 defines accumulator bit function.

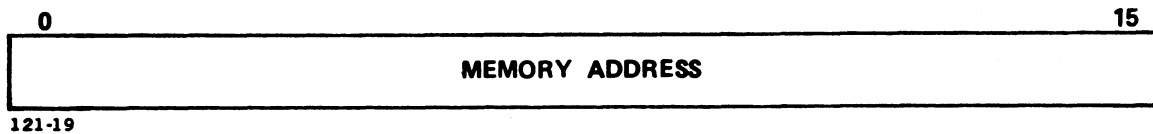


Figure 4-14. Specify Memory Address Instruction

TABLE 4-13. SPECIFY MEMORY ADDRESS BIT FUNCTION

Bits	Function
0-15	Memory address for the next data channel transfer.

4.2.14 SPECIFY BLOCK COUNT INSTRUCTION

Instruction Mnemonic: DOC[f] ac,42

Instruction Function: Loads bits 8-15 of the specified accumulator into the controller's block count register. Figure 4-15 illustrates the accumulator format for the Specify Block Count instruction. Table 4-14 defines accumulator bit functions.

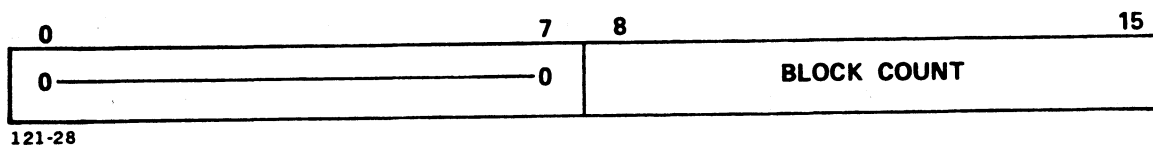


Figure 4-15. Specify Block Count Instruction

TABLE 4-14. SPECIFY BLOCK COUNT BIT FUNCTIONS

Bits	Function
0-7	Unused. Set to zero.
8-15	Two's complement of the number of data blocks to be transferred in a read or write operation. One block is 256 words (512 bytes).

4.2.16 READ MEMORY ADDRESS INSTRUCTION

Instruction Mnemonic: DIB[f] ac,42

Instruction Function: Loads the contents of the controller's memory address register into the specified accumulator. Figure 4-17 illustrates the accumulator format for the Read Memory Address instruction. Table 4-16 defines accumulator bit function.

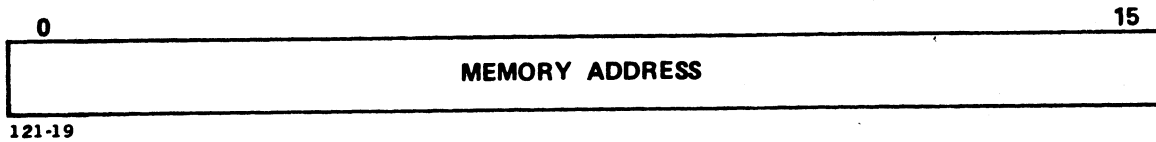


Figure 4-17. Read Memory Address Instruction

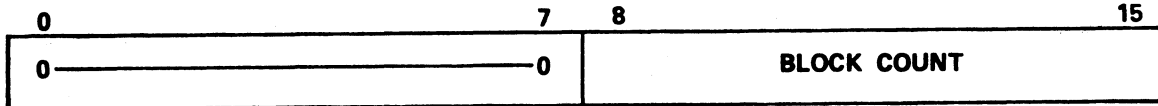
TABLE 4-16. READ MEMORY ADDRESS BIT FUNCTION

Bits	Function
0-15	Memory address of next data channel transfer.

4.2.17 READ BLOCK COUNT INSTRUCTION

Instruction Mnemonic: DIC[f] ac,42

Instruction Function: Loads the contents of the controller's block count register into the specified accumulator. Figure 4-18 illustrates the accumulator format for the Read Block Count instruction. Table 4-17 defines accumulator bit functions.



121-28

Figure 4-18. Read Block Count Instruction

TABLE 4-17. READ BLOCK COUNT BIT FUNCTIONS

Bits	Function
0-7	Unused. Set to zero.
8-15	Two's complement of the number of data blocks to be transferred in a read or write operation. One block is 256 words (512 bytes).

APPENDICES



Appendix A

POINT 4 SOFTWARE SUPPLIED ON 1/4-INCH STREAMING TAPE

A.1 INTRODUCTION

POINT 4 supplies software on 20MB tapes created on 20MB streaming tape drives using the QC-11 format. This appendix provides information for loading software supplied by POINT 4 using 20MB and 45MB streaming tape drives.

20MB drives supported by POINT 4 include the following:

- Archive 5920L-02 (5-1/4-inch)
- Cipher 420 (8-inch)
- Archive (8-inch)

45MB drives supported by POINT 4 include the following:

- Archive 5945L-02 (5-1/4-inch)
- Cipher 540 CT (5-1/4-inch)

POINT 4 uses the following terminology to describe tapes produced on these tape drives:

20MB tape = a tape containing data in QIC-11 format created on a 20MB tape drive

45MB tape = a tape containing data in QIC-24 format created on a 45MB tape drive

NOTE

20MB tapes may be read from 45MB drives. The reverse process is not supported.

A.2 REQUIREMENTS FOR READING 20MB TAPES ON 45MB DRIVES

POINT 4 20MB tapes may be used on a 45MB streaming tape drive provided the following requirements are met:

For a POINT 4 MARK 5, 8 or 9 system with a LOTUS 730 Multifunction Controller, the software requirements are:

- LOTUS DISCUTILITY 2.5 or later.

For a POINT 4 MARK 5, 8 or 9 system with a LOTUS 720 Streaming Tape Controller, the hardware and software requirements are:

- LOTUS 720 board PROMs: 27822CA at location 22C and 27823CA at location 23C. (Contact POINT 4 to arrange for factory upgrade.)
- ECO 1045 for the LOTUS 720 Streaming Tape Controller. If the LOTUS 720 board has the above PROMs, this ECO is installed.
- LOTUS DISCUTILITY 2.5 or later.

A.3 MANIP COMMAND FOR MARK 5/8/9 SYSTEMS

On MARK 5/8/9 systems, the LOTUS 720 or LOTUS 730 controller will first try to read the tape using the drive's default. If the tape cannot be read, the controller switches the drive's mode automatically.

To read a 20MB tape on a 45MB drive, enter

P42

A.4 USING DISCUTILITY TO READ 20MB TAPES FROM 45MB DRIVES

A 20MB tape that was SAVED on a 20MB drive may be RESTORED from a 45MB drive.

Appendix B

LOTUS 720/730 TAPE BOOTSTRAP PROM OPERATION

The MANIP command, P42, loads the contents of the bootstrap PROMs into the first 256 (decimal) words of memory. MANIP executes the instruction at location 377 (octal). This instruction is a jump to the beginning of the bootstrap routine. The bootstrap routine controls the following operations:

- Determines device code. Changes device code in routine. This allows the user to assign another device code to the controller. POINT 4 assigns device code 42 (octal) to the controller.
- Resets streaming cartridge tape drive status.
- Reads streaming cartridge tape drive status.
- Clears Interrupt flag.
- Checks Ready and BOT flags.
- Rewinds tape if not at BOT.
- Modifies reentry points for succeeding passes.
- Reads block 0 from tape.
- Waits for Done flag to set.

The bootstrap routine jumps to the address in location 377 (octal) after the Done flag sets. This indicates that a 20MB tape is used and block 0 has been read.

The bootstrap routine repeats if the tape is not a 20MB tape or location 377 (octal) contains the beginning address of the bootstrap routine.

The bootstrap routine issues a density change during the second pass. A Select Archive Mode command is issued first.

The bootstrap routine repeats a third time if block 0 is not read. The Select Read Cipher Quarterback Mode command is issued during the third pass.

Figures B-1 and B-2 are flowcharts of the bootstrap routine.

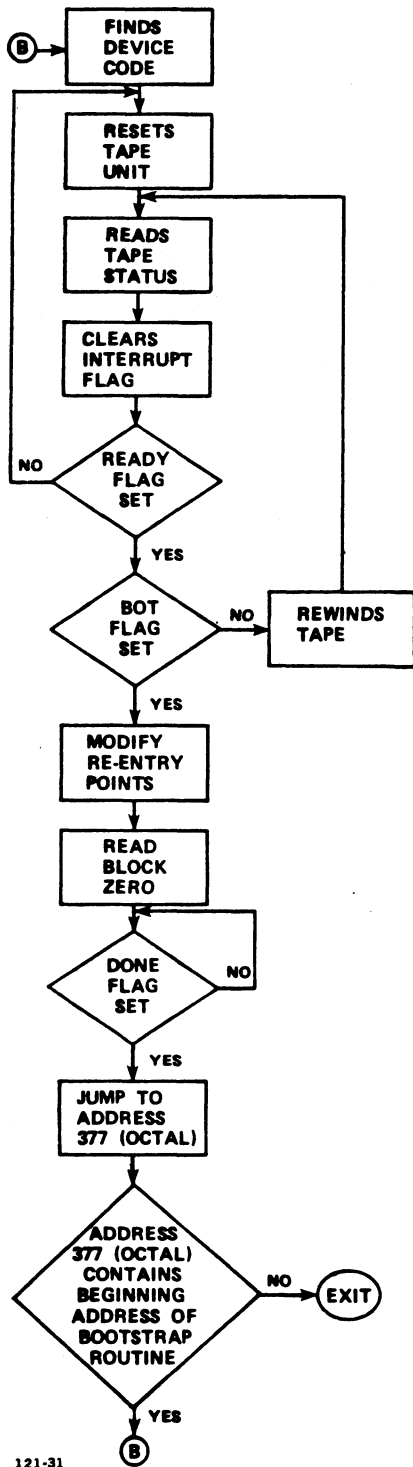


Figure B-1. Tape Bootstrap PROM (First Pass)

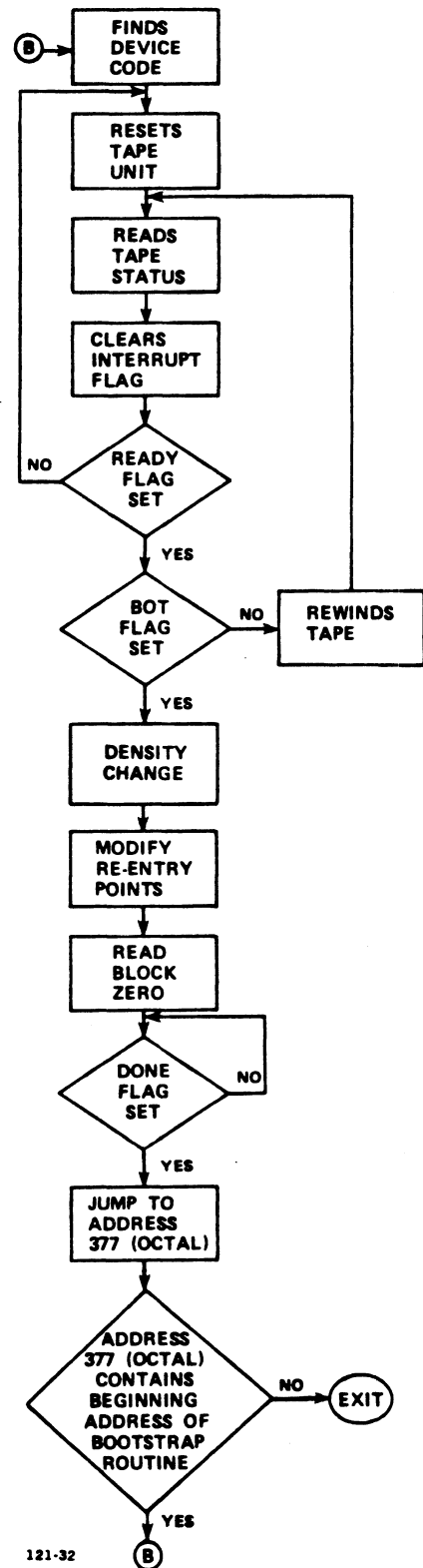


Figure B-2. Tape Bootstrap PROM (Succeeding Passes)

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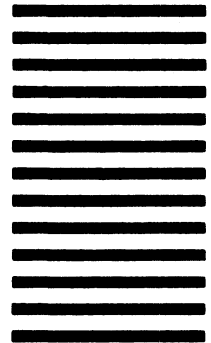
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